SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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No. VII.—PRELIMINARY REPORT ON THE COLLECTION OF MOLLUSCA AND BRACHIOPODA OBTAINED IN 1887-'88.

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(With Plates V to XIV.)

Before proceeding to discuss the particular specimens obtained on the voyage of the U. S. Fish Commission steamer *Albatross* from Fortress Monroe in Chesapeake Bay to Magellan Straits and northward to California, it may not be improper to say a few words on the conditions under which the deep-sea Mollusks exist, and the reasons why a study of these animals is important for science.

In order that their existence may be maintained, the abyssal mollusks require oxygen to aerate their circulation, food to eat, and a foot-hold upon which they may establish themselves. It is necessary that the conditions should be such as will not prevent the development of the eggs by which successive generations are propagated. That they do permit it may be assumed from the very fact that mollusks in large numbers have been shown beyond all question to exist on the oceanic floor wherever it has been explored.

Formerly, when dredging with the usual appliances in small boats, 100 fathoms (600 feet) was considered extremely deep. If one stands at the foot of the great Washington obelisk and looks up, the idea of collecting a satisfactory representation of the insects and plants on the ground at its base by dragging a 6-foot trawl or dredge by a line let down from the apex of the monument strikes one as preposterous. Yet the monument is less than 100 fathoms high. Multiply this height ten or fifteen times and the idea seems, if possible, still more unreasonable; yet it is a fact that successful dredging has been done from a height above the sea bottom of not less than twenty-five times the height of the Washington Monument. Living animals have been secured from a depth equalling the distance from the Capitol to Rock Creek, or from the Washington Monument to the Mansion at Arlington—that is to say, about 2½ miles.

It is therefore evident that in speaking of dredging we must revise our terms and define them so as to conform more nearly to the new conditions under which such work is done.

The waters immediately adjacent to the shores were long ago divided by Forbes and other pioneers in marine exploration into zones or areas, according to the conditions characterizing them; as, for instance, the Laminarian zone or region of brown kelp, the Coralline zone or region of stony algæ, etc. But for general purposes and to contrast the areas of the whole sea one with another, according to their chief characteristics, we may now divide the entire sea bottom into three regions.

The first is that to which light can penetrate, and therefore where marine vegetation can exist. This is the Litoral Region, and in a general way, modified by special conditions at particular places, it may be regarded as extending from the actual shore out to the limit of 100 fathoms. Beyond this it is practically certain that the light reaching the bottom is insufficient for the growth of sea-weeds. Outside of this the borders of the continents slope gradually to the bottom of the ocean, which is found usually at a depth of about 2,500 fathoms.

On the upper parts of these continental slopes the conditions are often very favorable for marine life. Currents of comparatively warm water, like the Gulf Stream, sweep along, bringing fresh pure water and supplies of food to the animals along their track. The division between the abysses and the slopes is rather a matter of temperature than of mere depth, but the temperature itself is somewhat dependent on the depth. The influence of the great warm currents rarely extends below 700 or 800 fathoms, and this depth corresponds roughly to a temperature of about 40° Fahr. Below this it diminishes as the depth increases at the rate of about one-tenth of a degree to 100 fathoms, until the freezing point is reached, though there is no reason to suppose that the abyssal water ever actually becomes congealed.

To this cold, dark area of the ocean bottom has been applied the name of the Benthal or Abyssal Region.

To the region chiefly on the continental slopes, between the Litoral and Abyssal regions, I gave, some years ago, the name of the Archibenthal Region.

These divisions have been recognized by various writers and have had several terms applied to them. Those I have mentioned seem to me as characteristic as any, and, in some respects, more convenient than any I have heard used.

Let us now consider the conditions under which life exists in the Abyssal and Archibenthal regions. It may be premised that the differences between them are largely of degree and not of kind and do not require that the two regions should be considered separately.

The chief characteristics reside in the composition of the sea water, including its contained gases; in the dynamic status of the deeps, especially in relation to temperature and pressure; in the mechanical quali-

ties of the materials of which the oceanic floor is composed; and, lastly, in the food supply.

As determined by physicists and chemists, the water of the deep sea varies in the proportions of mineral salts, carbonic acid, and air contained in it very much as does the surface water. In general, at the surface the warmer water of the tropics has the more salt and the less nitrogen. When carried by currents to the Polar regions and cooled this tropical water sinks to the bottom carrying its excess of salt along with it. The Polar waters are less saline and contain more nitrogen. The proportion of atmospheric air in the water is found strictly related to the temperature, the pressure at great depths being regarded as having no bearing on the question. The amount of oxygen in the sea water diminishes gradually as we descend from the surface until about 350 fathoms is reached, when it ceases to change, or, at most, increases slightly until the bottom is attained.

Carbonic acid, according to Tornoë, does not exist in a free state in sea water, but only in the form of carbonates, or, to a less degree, of bicarbonates. Unless the decomposition of animal matter in some manner sets free the carbonic acid, this conclusion is one which can not be adopted without question, especially when we consider the great difficulties which are encountered in any attempt to obtain, or when obtained to analyze, abyssal water. The effect of erosion on the shells dredged from the deeps, even when they contain the living animal, is so strongly marked, the devices for protection against erosion are so recognizable in various species, that the biologist may well call the physicist to a halt, while the latter re-examines his data. It is certain that erosive agencies, of which the effects are indistinguishable from those known to be due to carbonic acid in other instances, are extremely active in the deeps.

In general, it seems as if we might safely assume that the composition of abyssal sea water shows no very important differences from that of other sea water, and that the animals existing in it are not exposed to any peculiar influences arising from this source alone.

This can not be said of the physical conditions. Every one knows how oppressive to the bather is the weight of the sea water at only a few feet below the surface, and how difficult it is to dive, still more to remain on the bottom, if only for a few seconds.

But it is difficult to convey any adequate idea of the pressure at such a depth as 2,000 fathoms, or about 2 miles below the surface. Rope made impervious by tarring is said to have become reduced one-third in its diameter by a descent into these depths. Any hollow object not pervious or elastic is at once crushed. There is no doubt that at some points on the ocean floor the pressure may amount to several tons to the square inch. If we recall that the average pressure in steam boilers is probably much less than 100 pounds to the square inch, it may help towards an appreciation of the abyssal conditions.

The inevitable conclusion is, therefore, that all the animals living under these conditions must have their tissues so constituted as to permit the free permeation of the water through every part in order that the pressure may be equalized. How this is possible without putting an end to all organic functions is, perhaps, the greatest mystery of abyssal life. How can a large egg, like those of various deep-sea animals, pass through the stages of segmentation and development, with every molecule of its structure in actual contact with ordinary sea water and every solid particle subjected to a pressure of, say, a thousand pounds to the square inch? Such questions are much easier to ask than to answer; in fact, no attempt at an answer has, so far as I am aware, ever been offered to biologists.

The looseness of tissue necessary to such a permeation is conspicuous in abyssal animals, whose flabby and gelatinous appearance when they reach the surface is notorious. It is, perhaps, most noticeable in the fishes, which, nevertheless, are often armed with formidable teeth; but, under the great pressures of the deeps, it is quite conceivable that each of these loose and half-dissolving muscles may be compressed and reduced to a condition resembling steel wire, and that the organization thus sustained may be as lithe and sinewy in its native haunts as its shallow-water relatives are in theirs.

It is well known how great an influence on the distribution of shallow-water species is exerted by the temperature of the water in which they live. No doubt the differences of temperature affect the nervous system, the rate of muscular contraction and the motions of the cilia, by which in mollusks many of the functions of life are aided or wholly carried on.

But it is probable that the influence of temperature is far more effectively exerted upon the development of the ova, and hence upon the propagation of the species, than directly upon the parents. It is probable that most adult mollusks could endure a very wide range of temperature if the individuals were subjected to the changes by extremely slow degrees; but it has been shown that a difference of one or two degrees below a certain point on the thermometric scale will destroy the embryos of *Ostrea* or prevent their development, so that they perish. In this way the spread of the species may be effectually checked, though the adult shell-fish may flourish without difficulty in the same region.

In the shallower parts of the Archibenthal Region a few great currents like the Gulf Stream may reach, for a small part of their course, the ocean floor, and sweep it clean of sediment and detritus if not entirely of living beings. Such mechanical effect as is produced must be of a rather steady and uniform nature for considerable periods and in no respect resemble the crushing and grinding which take place on every exposed beach on which the sea rolls up. In fact, regarded as individuals, the mollusks in the path of the Gulf Stream and other

great currents have little or nothing to fear from the mechanical attrition which plays so large a part in the shallows. On the other hand, wherever the force of the stream is not sufficient to sweep the bottom clean, the supplies of oxygen and food brought by it to the colonies along its path so far exceed the normal for quiet waters that the animals thus favored flourish and multiply in a manner never seen in quiet deeps.

The influence of darkness upon the inhabitants of the Abyssal Region has often been expatiated upon. The absence of visual organs, or their preternaturally excessive development beyond the normal of the groups to which the individuals belong, is evidence enough that the deeps are markedly darker than the shallows. But this evidence proves too much for the claim that the deeps are mathematically dark. Whatever notions may be entertained or conclusions deduced by the physicist from the premises, the presence of large and remarkably developed eyes in many abyssal animals shows that light of some sort exists even on the oceanic floor. It is inconceivable that these organs should be developed without any light, and if the experiments and reasoning of the physicist result in the apparent demonstration of absolute darkness in the depths, the facts of nature show that in his premises or his experiments there lurks some vitiating error. It seems absurd to suppose that the phosphorescence of certain animals or parts of animals in the deep-sea fauna is a factor of sufficient importance to bring about the development of enormous and exquisitely constructed eyes in a multitude of deep-sea species. A greater or general phosphorescence, such as would amount to a general illumination, has never been claimed by any scientific biologist, and, as a theory, requires a mass of proof which seems unlikely to be forthcoming.

In general, then, we find the physical conditions simpler than those of the shallows and yet much more energetic. The effect of temperature is marked in the distribution of life over cold and warmer areas of sea bottom. The relative importance of the effects of pressure, partial darkness, and of the quietness of abyssal waters, our knowledge is yet too imperfect to allow us to precisely estimate. All, doubtless, have their effect; some of the effects are more obvious than others, but it is by no means certain that the most obvious are necessarily the most important to the organisms concerned.

The mechanical character of the sea bottom is of greater importance than is generally realized. In a very small proportion of its extent the sea bottom is composed of bare, or nearly bare, rock. Away from the shores such a bottom is usually situated in the trough of some great current like the Gulf Stream, and then seems to be nearly bare of animal life. In other cases it may be found on the walls of submarine cliffs, which, for obvious reasons, can hardly be explored for marine life with our present appliances.

The rest of the bottom consists of solid matter in different stages of

subdivision, from something which may be described as calcareous gravel to an impalpable mud which may or may not be dotted with concretions of manganese, iron, or other mineral matter. The gravels are chiefly confined to the Archibenthal Region; the true deeps are generally carpeted with a viscid layer of the finest possible calcareous mud or clay. The latter formation is meager in its fauna as clay is when it occurs in shallow water.

Certain forms of mollusk life flourish in a soft bottom, especially the *Nuculidæ* and their allies, which are notably abundant in the depths as well as in the muddy shallows of the Litoral Region. Others require some solid substance upon which to perch, a stone, a bit of wood, a spine from some dead echinoderm, something they must have for themselves and for their eggs which shall raise them above the muddy floor. In regions where such objects are rare or absent on the sea bottom such mollusks are equally rare or wanting. Most ingenious are the shifts made in many cases, as when we find *Lepetella* safely housed in the tubes of dead annelids or Hydroids, and *Choristes* taking refuge in the empty ovicapsules of rays or sharks. Small hermit crabs take to the tooth shells (*Dentalium*) or to the tubular Pteropods (*Curierina*), or *Amalthea* roosts on an *Echinus* spine and builds for itself a platform as it grows, recalling the arboreal houses of some Oriental savages.

In the Archibenthal Region there is a more or less constant drift of débris from the adjacent shallows which gradually forms banks of considerable magnitude. The action of erosion and solution for some reason seems less potent here than in either the shallower or the deeper parts of the sea. In the shallower parts the excess of motion, in the deeps the excess of the eroding agent, may account for this. The fact is known to me from the study of many specimens from both regions and is beyond question.

A feature in forming certain of these banks, to which attention has hitherto not been directed, is worthy of mention. This is the habit of certain fishes, which exist in vast numbers, of frequenting certain areas where they eject the broken shells of mollusks, corals, barnacles, and other creatures which they have cracked, swallowed, and cleansed of their soft tissues by digestion. We have learned from Darwin of the marvelous work of the earth-worm in Britain. The ejectamenta of a single fish of moderate size in one day would far exceed the accumulations of many earth-worms for a much longer time. Now, in examining critically large quantities dredged from the bottom, I have found the material from certain areas almost entirely composed of these ejectamenta. In the interstices some small creatures hide, but the tooth marks of the fish were upon nearly every fragment. As, for a pint of fragments of a given species, this bottom stuff would rarely contain half a dozen specimens which had been taken alive by the dredge (most frequently the species did not occur at all living in the material so dredged), it was obviously impossible that the shells could have been

captured and afterward voided on the same spot. It seemed more likely from all the facts that these fishes, after feeding to repletion, repair in large schools to certain areas to enjoy the pleasures of digestion. There would be nothing improbable in the fish of a limited region preferring some special locality for this purpose, and the result might be the accumulation of a veritable bank, of which nearly the whole had at some time or other passed through the intestine of a fish. At all events, whatever explanation be offered of them, it is certain that such accumulations do occur at certain localities, as shown by the dredgings of the Fish Commission off the eastern coast of the United States.

The last condition remaining to be considered is that of the food supply. It has long since been pointed out that marine vegetation ceases to exist within a limit of 600 feet below the surface. Whatever light exists in the depths it is not of a nature to meet the needs of vegetation. Whether any other factor joins with the absence of light to discourage algal growth is yet unknown, but not intrinsically improbable. The mollusks which belong to groups known as phytophagous in shallow water, in the deeps appear to live chiefly on foraminifera which they swallow in immense quantities. The results of this diet are evident in the greatly increased caliber of the intestine relative to the size of the animal, in the diminution of the masticatory organs, teeth, and jaws, and in the prolongation of the termination of the intestine as a free tube to a length which will carry the fæces out of the nuchal commissure, and thus free from their injurious effects the branchial organs, which are usually seated in this space. The quantity of nutriment in the protoplasm of foraminifera is so small that a much larger mass in proportion of these organisms must be swallowed, and their remains consequently ejected afterward, than if the food consisted of the tissues of algæ.

But the great mass of abyssal mollusks are members of those groups which in shallow waters are normally carnivorous, and to a great extent prey upon one another. In the deeps, however, this reciprocal destruction is unnecessary.

Those who have become familiar with surface collecting on the sea, alone can realize the immense quantity of organisms which exist in the water on or near the surface. These are frequently numerous enough to reduce the water to the consistency of soup for miles in extent and to a considerable depth. Millions of these creatures are constantly sinking from the region where they naturally belong, either from injury or exhaustion, and thus raining slowly but constantly upon the bottom. This fact is not new and is admitted to be unquestionable by all biologists. Hence in many regions of the sea bottom the resident fauna have, as it were, only to lie still and hold their mouths open.

One of the facts which attracted my attention when I first began to study deep-sea mollusks was the singularly small number which showed signs of having been drilled or attacked by other mollusks. Apart from

those showing the marks of fish teeth, or the dental machinery of echinoderms, it is extremely rare to find drilled bivalves or univalves such as make up the great mass of the jetsam on every sandy beach. Such cases occur, but the occurrence is always exceptional and the holes which are most often found in abyssal shells are those which are due either to the friction of some hermit crab or to the erosive properties of the secretions of certain annelids which fix their irregular tubes upon the outer surface of the shell. These injuries can not easily be confounded with the circular drill-holes of carnivorous gastropods. Having handled more deep-sea mollusks than any other naturalist now living, and spent, probably, more time over material procured by the dredge from shallow water than any one else of my acquaintance, I do not feel that I am presumptuous in affirming the remarkable difference which obtains in this respect between the dead material from the Litoral and from the Extra-Litoral Regions, respectively.

This brings me to a conclusion which I have elsewhere published with less detail. The animals belonging to the mollusca which are found in the Archibenthal and Abyssal regions, especially the latter, do not live in a perpetual state of conflict with one another. A certain amount of contention and destruction doubtless goes on, but on the whole the struggle for existence is against the peculiarities of the environment and not between the individual mollusks of the area concerned. It is an industrial community, feeding, propagating, and dying in the persons of its members, and not a scene of carnage where the strong preys upon his molluscan brother who may chance to be weaker. Depredations on this community are doubtless committed by deep-sea fishes and echini, perhaps by other organisms, but the inroads are not so important as to seriously modify the course of evolution and influence specific characteristics.

Hence the course of evolution and modification, though still complex, is certainly much less so than in the shallower parts of the ocean. For this reason we may hope to penetrate more deeply into its mysteries with deep-sea animals than with those less fortunately situated. In this opportunity, it seems to me, lies the chief importance of research into the biology of deep sea mollusks. Nowhere else may we hope to find the action and reaction of the contending forces less obscure, and modification in most cases has not extended so far that we can not compare the deep sea forms with their shallow-water analogues and draw valuable conclusions.

While we are not yet in a position to formulate conclusions covering all the details of abyssal mollusk-life, in certain instances results suggest themselves.

Deep-sea mollusks, of course, did not originate in the deeps. They are the descendants of those venturesome or unfortunate individuals who, by circumstances carried beyond their usual depth, managed to adapt themselves to their new surroundings, survive, and propagate.

Many species must have been eliminated to begin with. Others more plastic, or more numerous in individuals, survived the shock and have gradually spread over great areas of the oceanic floor. In accordance with these not unreasonable assumptions we should expect to find, at least among the newer comers, some characters which were assumed under the stress of the struggle for existence in the shallows, and which, through specific inertia, have not become wholly obsolete in the new environment. We should also expect to find a certain proportion of archibenthal species in any given area, identical with or closely related to the analogous Litoral Region forms of the adjacent shores.

In the Abyssal Region alone should we expect to find that any considerable proportion of the fauna has lost all its litoral characteristics, assumed characters in keeping with its environment, and become disseminated over the ocean bottom throughout a large part of its extent. These expectations in the main are fairly satisfied by the facts as far as the latter are positively ascertained.

With the lesser need of protection from enemies and competitors would necessarily be related a less vigorous elimination of characters which in struggle and competition might prove sources of weakness. The limits of uninjurious variation would be relaxed at the same time and to the same extent. We find, as we should expect, that the deep-sea mollusks are more variable in their ornamentation and other superficial characters than those from shallow water. In some species the balance of characters is fairly well maintained, in others variation runs riot, and it is impossible to say what amount of it should constitute a basis for specific subdivisions among individuals.

In general, deep-sea shells present pale or delicately tinted color-patterns, are white or owe their color to the tinting of the epidermis. This may be due directly to the absence of light. Sunlight, when present, seems to have a stimulating effect in developing colors as is shown by the greater brightness of tropical litoral shells whatever their colors. It operates indirectly by promoting the development of color in algæ which are fed upon by phytophagous mollusks and affect the coloration of the latter directly through the assimilation of the coloring matter of the food, mechanically. Indirectly, through the influence of protective mimicry, the coloration of shells which frequent beds of seaweed or rocks covered with stony algæ is often modified in harmony with the environment even when the species is not phytophagous. In the deeps these influences are wanting, and the development of color is necessarily the result either of uneradicated hereditary tendency, or of some physical features of the environment which operate mechanically and are not yet understood.

The colors chiefly affected by deep-sea mollusks are pink or reddish, straw-color, and various shades of brown. These are found in the shell and are more or less permanent. The epidermis of deep-sea shells is usually pale yellowish, but frequently is of a delicate apple-green such

as is seen in many fresh-water species; and sometimes of a beautiful rich dark chestnut-brown, a color also not rare among land and fresh-water species. The most common pattern when any exists is that formed by squarish dark spots, which occasionally become fused into bands. Among the archibenthal species found in depths from 100 to 300 fathoms this pattern of brown squarish spots arranged in spiral series is notable in such forms as *Scaphella junonia*, *Aurinia dubia*, *Halia priamus*, *Conus mazei*, etc. Instances of the green epidermis are afforded by the various species of *Nuculidæ*, *Turcicula*, and *Buccinidæ*.

The thick and solid layers of aragonite, of which many shallow-water species are chiefly built up, are represented in deep-water forms by much thinner layers, while the nacreous layers are, if not more solid in abyssal shells, at least more brilliant and conspicuous, perhaps because less masked by aragonitic deposits. A very large proportion of the deep-water shells are pearly and derive their beauty from the brilliance of their nacre.

In the matter of sculpture the mechanical effect of the pressure operates against the development of weight and thickness in benthal shells since the whole must be permeable. It is probable, too, that the soft and sticky character of the abyssal ooze would put the possessor of an unusually heavy shell at a considerable disadvantage in getting about on the bottom. Any impermeable shelly structure on the ocean floor would have to be strong enough to sustain without crushing a weight hardly less than that borne by the rail under the driving-wheel of an ordinary locomotive. It is sufficiently obvious from a mere statement of the case that none of them can be impermeable.

The heavy knobs or arborescent varices of shallow-water Murices are represented in their deep-water congeners by extremely thin and delicate spines and slender processes. These are probably all reminiscences of shallow-water ancestors, as it is difficult to imagine any cause which in the abysses would lead to a development of such defenses *de novo*.

The sculpture most usual on deep-water shells is of a kind which serves to strengthen the structure, much like the ridges which give rigidity to corrugated-iron work, or the curves used by architects in wrought-iron beams. Spiral or longitudinal hollow riblets, a transverse lattice work of elevated laminæ such as are developed for similar reasons on the frail larval shells of many gastropods, a recurvature of the margin of the aperture in forms which in the Litoral Region never develop such recurvature—these are instances in point.

Besides these there are small props and buttresses developed which serve the same purpose of strengthening the frail structure at its points of least resistance. Such are the garlands of little knobs so commonly found in front of the suture in abyssal shells of many and diverse groups.

It is not intended to suggest that the methods above indicated have

not been developed also in shallow-water forms and for similar reasons. The distinction which I would point out is that in litoral species, as a rule, these devices are subsidiary to the much simpler course of strengthening the shell by adding to its thickness. In the abyssal forms, for reasons already explained, this mode is not practicable and consequently we have the one without the other. The operculum is generally horny in abyssal mollusks, frequently disproportionately small, compared with that of congeneric litoral species, and in a remarkably large number of cases is absent altogether.

As might be expected of descendants with modification, the resemblance is greater between the larval shells of benthal species and those of their shallow-water relatives than between the parts of the shell of later growth. There is one notable difference, however. In the deep-water forms the nucleus is frequently larger than in their litoral analogues. It would seem as if the condition of the depths were such that of a small number of large larvæ more are more likely to survive than of a large number of small ones; or at least that this form of reproduction is more useful to the species. These details will serve to show the multiplicity of facts to be accounted for and the opportunity for advancing science by a study of abyssal conditions and their effects upon the animals subjected to them. Without claiming any unique importance for the theories advanced in the foregoing remarks it may still be said that the subject is one of the very greatest interest. Perhaps experiments upon shallow-water forms, artificially subjected to pressure, may at some future time enable us to penetrate more deeply into the mysteries of life in the abysses.

It now remains to take up the collections made by the *Albatross* party on their voyage.

Beginning the enumeration at Santa Lucia in the West Indies, and terminating it at San Francisco, California, it appears that the register of operations includes one hundred and forty dredging stations and forty anchorages, besides sundry surface collections. From the inspection of the collection of mollusks, which is almost entirely preserved in alcohol, it seems that mollusks were collected in eighty of the casts of the dredge or trawl, and at twenty-seven of the anchorages, distributed as follows:

On the Atlantic coast of America and in the Straits of Magellan, sixteen stations and eleven anchorages are represented, of which eight casts were in water over 100 fathoms deep.

On the Pacific coast of South America from the Straits of Magellan to Panama and to the Galapagos Islands mollusks were collected at thirty-nine stations and twelve anchorages. At eleven American stations and three near the Galapagos Islands the depth was over 100 fathoms.

On the Mexican and Central American coast north of Panama mol-

lusks were obtained at twenty stations and six anchorages, none of which were in more than 100 fathoms.

Lastly, on the coast of California at five stations, of which two were in more than 100 fathoms, and at three anchorages, mollusks were collected.

Altogether the dredgings on archibenthal grounds amounted to twenty-four, all told. The mollusk collection made at these stations was very small in bulk, though important in its nature.

The collections can be roughly divided into two classes. The first, from the Litoral Region, is of value as indicating the distribution of the species, and as affording rare specimens with the soft parts in condition for study. The full value of this part of the collection will not be evident until the whole has been thoroughly studied, compared, and named, which will necessarily be a work of considerable duration.

The second portion of the collection is that containing the deep water species whose interest is of a wider sort, for reasons already discussed. Being so much smaller in bulk it can be readily handled and discussed, especially in connection with previous work done in the region between Chesapeake Bay and the northern shores of South America.

I shall therefore in this report, which is avowedly of a wholly preliminary nature, confine my attention chiefly to the deep-sea forms of both oceans and the Atlantic shallow-water species; combining with those collected on the voyage from ocean to ocean a few, obtained by the *Albatross* in previous work on our southeastern coast, which naturally fall into the same category, and including with the merely descriptive matter a discussion of some points in regard to the anatomy and biography of these species. A supplementary report on the shallow-water forms of the Pacific collected on the voyage is in preparation by Dr. R. E. C. Stearns.

In a general way, before dismissing the shallow-water collections from consideration, I may point out that the collections from the eastern shores of the two Americas are of great value as extending our knowledge of the geographical distribution of many species. Thus we find that a good many of the forms common to the shores of Florida and the Gulf of Mexico, as well as the Antilles, extend to the Abrolhos Islands or even to Rio Janeiro, while, mixed with them, are a few which seem to find their normal geographical center near the southern extremity of South America. On the west coast of South America the shore collections offer nothing unexpected and the collections from the shores of the Galapagos Islands are unfortunately meager. Those from moderate depths of water off the coast of Lower California, on the other hand, show glimpses of a fauna apparently as rich as that of the Antilles and which has so far been little investigated.

The archibenthal fauna off the coast of Alta California, like that off the shoals of Nantucket and Martha's Vineyard in New England, shows an almost entirely distinct facies from that of the shallower water near

the shores, and in the future will doubtless afford a rich harvest of novelties to the naturalists who investigate its treasures. The present contribution to that branch of the subject is a mere beginning in a line which promises rich results when more effectively explored.

In conclusion I would express my appreciation of the facilities offered by the authorities of the Fish Commission, the National Museum, and the Smithsonian Institution in the preparation of this report.

NOTES ON THE SPECIES COLLECTED.

Class BRACHIOPODA.

The collection of *Brachiopoda* made on the voyage was small and of little interest. Only one species, represented by two specimens, was an addition to the Museum collection. The localities and data have a certain value for students of the group.

Family EUDESIIDÆ.

Eudesia venosa Solander.

This species was obtained from latitude 45° south, off the east coast of South America, near Point Malaspina southward to Magellan Straits, in 20 to 80 fathoms, the temperature varying from 47° to 57° F. The station numbers were 2769, 2770, 2772, 2775, 2777, 2778, and 2779.

Eudesia fontaineana Orbigny.

Terebratula fontaineana Orb. Voy. Am. Mer., v., p. 675, No. 782, ix, pl. 85, figs. 30, 31.
Waldheimia venosa (pars) Dall, Proc. Acad. Nat. Sci., Phil., p. 183, 1873, not of Solander.

HAB.—Station 2783, off the west coast of Patagonia, in south latitude 51° 2′, in 122 fathoms mud; bottom temperature 47°.9 F.

This interesting species appears to be very rare; the only other specimens I have heard of are the original types of Orbigny, in the Paris Museum, which I have never seen. His figure is excellent, but rather too inflated, which led me in 1873 to refer the species, though with some doubt, to *E. venosa* as a synonym. An examination of the present specimens leaves no doubt of the validity of the species. Externally it much resembles a large, smooth specimen of *Terebratulina caputserpentis* var. *septentrionalis*. The ramifications of the sinuses are white and form two blunt rather short channels on each side of each valve. They have no small attenuated divarications as in *E. venosa*. The exterior is mostly of a russet-brown color, but this may possibly be extraneous. The soft parts and apophyses do not differ from the usual type in this genus.

Terebratella dorsata Gmelin.

This species was, on the east coast of South America, not obtained north of south latitude 52°, near Cape Virgins, but elsewhere was associated with *E. venosa* and obtained through the same range of depth and

temperature at Stations 2772, 2775, 2777, 2778, 2779 and at various points in Magellan Straits.

Bouchardia rosea Mawe.

Special search for this species was enjoined in the instructions to the collectors of the expedition, as the soft parts are not yet known and the shell is very peculiar. The only results were the dredging of a number of valves and dead shells at Station 2762, in south latitude 23° 08′ and west longitude 41° 34′, east of Rio Janeiro in 59 fathoms mud and gravel; bottom temperature 57°.1 F.

Family TEREBRATULIDÆ.

Terebratulina cailleti Crosse.

This well known Antillean species was obtained at Station 2750, off St. Bartholomew, West Indies, in 496 fathoms sand, and at Stations 2752 and 2753 in 281 fathoms sand off Santa Lucia, the bottom temperatures ranging from 44°.4 to 48° F.

Family LINGULIDÆ.

Glottidia albida Hinds.

This species was dredged in 5 fathoms mud, off the coast of Lower California, in north latitude 26° 42′.

Family CRANIIDÆ.

Crania pourtalesii Dall.

HAB.—Station 2,781 in south latitude 51° 52′ west, longitude 73° 41′ on the west coast of Patagonia in 348 fathoms mud; bottom temperature 50° F.

This species had previously been obtained only from the Florida reefs and in the Antillean region in deep water. The discovery of it at the present locality not only carries it southward to the Straits of Magellan but to the western coast of South America, where this genus has not hitherto been known, either as recent or fossil.

Class PELECYPODA.

GENERAL CONSIDERATIONS.

The attempt to divide the class *Pelecypoda* or *Lamellibranchiata* into orders has so far been unsuccessful, or, at least, the subdivisions adopted have from time to time been found unsatisfactory on account of the discovery of forms which combine in their organization characters which had previously been regarded as diagnostic of important subdivisions, such as orders.

This has resulted from the selection of characters as diagnostic which are not really fundamental in the evolutionary history of the minor

groups. As we gradually become acquainted with the mutability of the adductor muscles, the gills, the arrangements for retracting the siphons and other factors in the mechanics of these organisms, the classification based upon their mutations has gradually ceased to satisfy students, though one phase or another of it may still retain a place in ordinary text-books.

To cite a few examples: It will be remembered that the most persistent of the early systems for classifying these animals was based on the number of adductor muscles or the scars upon the shell by which they might be traced. At first the groups of Monomyarians, or forms with one adductor like the oyster, and Dimyarians with two adductors, like the ordinary edible clam, seemed sufficiently well distinguished. Later when transitional forms like the mussel and its allies were carefully studied, a new group, *Heteromyaria*, was erected for those which would not fit into either of the others.

But when it is considered that there are forms like *Dimya*, in which with a monomyarian organization two distinct adductors are found, one at each end of the shell; that in *Chlamydoconcha* we have a specially modified animal with no adductors at all; that in *Mulleria* we have the young (not larval) animal typically dimyarian yet becoming in its adult stage as typically monomyarian in its muscular apparatus as an oyster; then it is sufficiently evident that better and more fundamental diagnostic characters should be found or the so-called orders given up.

Again, an attempt has been made to use the characters of one of the most mutable parts of the whole organism, namely the gill, as a basis for primary divisions of the group. I have shown elsewhere, I venture to think conclusively, that this selection is ill-advised and can not successfully solve the problem.

The simplicity or sinuation of the pallial line has been regarded as a character of high importance and has been used as diagnostic of divisions of primary importance. I have recently shown that, in certain groups, long siphons may exist with a simple pallial line, as in *Cuspidaria;* that in species without long siphons, members of the same family *Poromyidæ*, and perhaps of the same genus, may show a simple or a strongly sinuated pallial line according to the modifications of certain muscular elements which certainly can not be claimed to have any high systematic importance.

The question is further complicated by the fact that certain characters which in general are indicative of very early evolutionary divergencies, may be simulated or assumed as very modern special modifications brought about in animals of diverse groups by natural selection under the influence of special circumstances. Species thus modified will very naturally be classed with those who bear the same or similar characters as the early result of very ancient ancestral divergencies, and, as a consequence, other characters not harmonizing, the systems are thrown into confusion. These are the difficulties among which the sum total

of the organic characters must be our guide in attempting to decide. Only too often we may find, as knowledge increases, that our first judgment was more or less in error.

In reflecting upon the origin of the complicated mechanical arrangements in bivalves which we call the hinge, I have come to the conclusion that here, as in the cases of the mammalian foot and tooth, elaborated so clearly by Cope and Ryder, we have the result of influences of a mechanical nature operating upon an organ or apparatus in the process of development.

The hinge of a bivalve, reduced to its ultimate terms, consists of two more or less rigid edges of shell united by a flexible membrane or ligament.

The ligament may be wholly external or may be supplemented by an internal addendum (called the cartilage), which exerts a stress in the same direction, within certain limits. The movements of the hinge are dependent upon the elasticity of the ligament and cartilage and upon force exerted by one or more adductor muscles connecting the valves.

The rigid edges or cardinal margins of the valves may be simple or modified by the presence of interlocking processes, known as teeth, whose purpose is to regulate the direction of the valves in opening and closing.

There are three fundamental types of hinge: (1) The simple edentulous margin closing by simple apposition of the edges of the two valves; (2) the hinge in which the teeth are developed in a direction transverse to the cardinal margin; and (3) the hinge in which the direction of the teeth is parallel to the margin.

The mechanical features of the second and third types may be more or less combined in a single hinge, but the affinities of the particular form in which this may occur are usually not difficult to determine on a general survey of all its organic characters.

I am disposed to think that the time relations of the different types are those of the order in which I have cited them; the most perfect hinge, morphologically speaking, would be one which should combine the most effective features of the second and third types.

The architypal form of bivalve may be imagined as small, with nearly equilateral, symmetrical, subcircular valves with edentulous cardinal margin and a short external ligament nearly central between the umbones. This is the character of many larval bivalves at the present day, though it is probable that many of the forms now edentulous in the adult state, have passed through an evolutionary stage in which they had a more or less denticulate hinge margin, while their present condition is one in which the hinge has diminished in complexity, or, in other words, undergone degeneration.

Very few of the earliest known bivalves appear to have hinge teeth, though this may be on account of our imperfect knowledge of many of them, since they are often represented by fossils in which no evidence

of the hinge structure is discernible. It is highly probable that the evolution of hinge teeth closely followed the differentiation of the Pelecypod class.

The first bivalves are all minute, as far as known, when compared with a majority of their descendants. They are usually Dimyarian, as I assume the architype to have been. It is highly probable that they possessed a developed foot and that their gills were either lamelliform on either side of an arterial stem, as in *Nucula*, *Solenomya*, and many Gastropods, or filiform, as in *Dimya* and certain Pectens. The siphons were probably little developed and the lobes of the mantle rather widely separated, or perhaps entirely free.

As long as the shell remained small and subglobular the ligament short and wholly internal, the imperfect character of the hinge was of less importance. With the essential difference between the anterior and the posterior halves of the animal, and especially with any material increase in the magnitude of the adult, more or less discrepancy would develop itself between the two ends of the shell, the subglobular form would disappear, and certain other consequences would follow. Either the ligament must increase with the size of the shell and become longer or its power would become inadequate for the proper performance of its functions.

Here I will turn aside for a moment from the direct line of argument to describe the mechanical relations of ligament and shell, a proper understanding of which is very necessary to the comprehension of the whole question.

With a wholly external ligament the operation of the valves is that of two appendages to the free ends of a C-shaped spring. The action of the muscles in pulling the valves together includes the bringing nearer to each other of the two extremities of the ligament, which the latter by its elasticity resists; consequently the operation of the ligament is in the direction of opening the valves to a certain distance. Beyond this distance the separation of the valves tends to compress the ligament, which again resists, and therefore beyond the normal distance of separation the action of the ligament tends to prevent the valves from opening. This very simple matter may be observed by any one who will examine an ordinary clam with the ligament in fresh condition and whose adductor muscles have been severed.

When the ligament, in harmony with the elongation of the cardinal margin, becomes elongated it must be either straight or angulated. For obvious reasons a ligament forming a curve or the arc of a circle is mechanically impossible. This any one can prove to their own satisfaction by putting two light wooden saucers edge to edge, convexity outward, and attaching a leather or paper ligament by cement. A curved ligament, when the valves open, will tear or break at once either itself or the edge to which it is fixed. In other words, the axis of motion of the hinge must be a straight line. If any part of the ligament diverges

from the axial line it must cease to take part in the axial motion and must be capable of stretching to an extent which will neutralize its angulation, or it will be broken or torn away. But if the thickness of the ligament increases ventrally, as may be the case, when it is situated between the valves rather than as an arch above them, a certain portion may extend to and beyond the axial plane in a downward direction. The portion thus projecting will then partake of the axial motion in an opposite sense to that portion which remains above the axial line. It will be compressed when the latter is stretched by the closing of the valves and will expand as the opening of the valves allows the external portion to contract. This change may be brought about by a downward angulation of one end of the ligament (as in *Solenomya*) or as a simple downward growth, which may be central as in *Neilonella* or *Galeomma*). The former mode may be the result of an angulation of the hinge margin consequent on elongation or ventral extension. Its result is to separate a longitudinal segment of the original ligament, which may be totally detached or remain physically connected, while in either case its mechanical function has undergone a reversal of direction.

The second mode likewise removes a segment, but in a vertical direction. This segment may be physically continuous throughout its upper portion with the lower portion of the superjacent ligament. It may be wholly detached, or it may be attached by one extremity while the other is separated. In the last case its direction will be oblique, or at an acute angle with that of the original ligament. This detached segment, whatever its position, has always similar mechanical relations to the movement of the hinge, and is called a cartilage. The separation of the cartilage from the ligament is generally either central or toward the shortest end of the hinge, which is usually the anterior, owing to the fact that when the size of a lamellibranch increases, the siphons, the ovaries, the visceral mass, or the gills are the organs where proportionally increased growth is most likely to occur, and these are usually central or posterior to the umbones. In *Solenomya*, which is exceptional in having a posterior cartilage, the posterior portion is the shortest.

The amount of shifting required to put part of the ligament on the ventral side of the axis of hinge motion, or cardinal axis, is extremely small. All stages of the changes involved may be observed in the *Nuculacea*, even to one, not hitherto mentioned, where the cartilage has been developed and has subsequently become obsolete or altogether disappeared (*Malletia*), while leaving some traces of its former presence in the shape of an empty and degenerate fossette (*Pleurodon*). It is noteworthy that this suborder, which gives us so many hints as to processes which we may imagine to be of great antiquity, should, on other grounds, be regarded as among the few which best retain traces in the soft parts of archaic stages of development.

With the lengthening and angulation of the cardinal margin the ligament gradually shifted to a point where it became posterior to the beaks. Perhaps it would be better to say that the portion in front of the beaks either became segmented off as a cartilage, or became obsolete and vanished, while the portion on the posterior side gradually elongated, as the elongation of the posterior hinge-margin rendered a longer ligament more useful. It has already been pointed out that a curved ligament would involve stresses leading to its own destruction. The curvature of the cardinal margin, now the common property of a vast majority of bivalves, was inevitable with increase in size and asymmetrical development of the anterior and posterior ends of the body. Consequently, that the ligament should be shifted was a mechanical necessity unless the evolution of the group was to be confined within extremely narrow limits as regards hinge characters.

The infolding of the ligament, and the development of a cartilage and its supports, would be especially likely to occur in forms with a thin edentulous hinge, where the least shifting would be necessary (*Solenomya*, *Anatina*), rather than in those with a broad, flat hinge margin. In harmony with this proposition, we find the archaic forms, with internal cartilage, have generally a narrow edentulous cardinal border, the exceptions belonging to the more recently specialized types (*Mactra*, *Spondylus*), while the groups without an internal cartilage contain the broadest and heaviest types of hinge (*Pectunculus*, *Veneridæ*).

The infolding of a cartilage which arose by longitudinal segmentation would leave a line of weakness in the arch of the umbones. In thin shells with strong adductors there would be a tendency to fracture here. This singular feature has been perpetuated in what may be termed the normal umbonal fissure of *Solenomya*, *Periploma*, and similar forms. Traces of it are evident in *Thracia*, while the unfractured suture itself is visible in *Isocardia*, *Pachyrisma*, and *Pecchiolia*.

In the thin-shelled *Cuspidariidæ* a special buttress is often developed to support the shell at this weak point. In the *Isocardiidæ* an independent cartilage was possibly never developed, but the infolding of the anterior part of the ligament went far enough to leave permanent traces on the shell. That it did not result in a cartilage, if this was the case, may possibly be due to the fact that, owing to the great size and spiral character of the umbones, the anterior part of the ligament was turned up instead of downward, and therefore did not tend to shift toward the interior. If it is not clear how the thickening or vertical extension of the ligament below the cardinal axis should cause its separation into two parts, I need only recall the familiar experience of every one in breaking off a wire or piece of tin by bending it backward and forward on the line of the desired fracture. The mechanical principles and results in the two cases are precisely similar.

When finally developed in the same individual the ligament and cartilage work in identically the same manner but in different directions.

The resistance of the ligament to compression prevents any straining of the adductors by a too wide opening of the valves. The same resistance in the cartilage prevents the ventral margins from crushing each other by sudden and violent contractions of the adductors when the animal is alarmed and closes its valves. The nymphæ, or processes to which the ligament is attached, and the fossette or socket of the cartilage have been strengthened and regulated by the development of various buttresses and other devices, varying in different groups. The cartilage in turn has its rigidity and strength increased in many species by the special development of shell substance known as the ossiculum.

To return to the development of the cardinal margin. The asymmetry of the shell and ligament, relative to a vertical transverse plane passing through the umbones, would be promoted not only by the natural discrepancies between the anterior and posterior halves of the body, but by the mechanical effect of the projecting umbones. Where a shell opens laterally in the strict sense of the word, unless the beaks are very inconspicuous, or are separated by a wide projection of the cardinal border (as in *Arca nox*), they will strike against and wear out one another. This abnormal or accidental result is very constantly observable in many *Anatinidæ*, such as our own *Thracia conradi*. But it must be a source of weakness and danger to the animal. If the ligament is shifted posteriorly, the valves must open more obliquely, with the result that this dangerous friction will be avoided in most cases.

In a protective armor like the valves of bivalves, other things being equal, it will be obviously beneficial, if not absolutely essential, that it should offer as few weak joints or open spaces as possible. Burrowing animals, who serve themselves of their burrow as a supplementary defense, may be able to perpetuate gaping shells and exposed siphons without serious danger from their enemies. Those animals which burrow but slightly, or live in material which enemies may also easily penetrate in their forays, will unquestionably benefit greatly by an accurate and exact closure of the valves. The intrusion of solid bodies can be to some extent guarded against by the action of the cilia or processes of the mantle margin, but such intrusion would be greatly facilitated by any organization of the hinge which would permit an independent rocking motion of the valves with respect to each other. The sudden closing which danger incites leaves no time for clearing out obstructions, and the gap is especially liable to the incursion of gravel, etc., in species which live with the plane of junction of the valves in a vertical direction. In certain brachiopods, such as *Glottidia* and *Discina*, such a semi-rotary motion of the valves exists, but is less dangerous to them since the plane of juncture with them appears to be generally horizontal.

To avoid these dangers and to guide the motion of the valves in closing and to prevent their sliding upon one another after closing, nature through natural selection and physical stresses has developed these cardinal processes which are known as teeth.

Attention has already been called to the fact that there can be but three fundamental types of hinge, which may be called the anodont, prionodont, and orthodont, the latter term being used to indicate the forms in which the cardinal margin has become longitudinally plicate. Actually the pure orthodont type hardly exists; in nearly all forms traces of the prionodont characters are mingled with it. For those forms, in which the archaic anodontism still persists as the characteristic of chief importance, though frequently modified by special mechanical contrivances which to a certain extent mask the type, I have proposed the term *Anomalodesmacea*. The fossette, cuilleron, or spoon-shaped process for the cartilage is a separate development, serving a special purpose. Though influencing the teeth, if any exist, in its vicinity, it must not be confounded with them. The weakness of the anodont type has left an opening for the specialization and perfection of this process, which, to a considerable extent, in this group, assumes the functions which in groups without a cartilage are the special office of the teeth.

For those forms in which transverse plication of the hinge is the chief characteristic, though rarely wholly exclusive of the orthodont influence, I have used the term *Prionodesmacea*. In some cases what may seem to be the chief features of the hinge as regards size and strength are orthodont, yet these I believe to be comparatively modern specializations illustrating the general tendency of evolutionary processes toward a teleodont hinge. In cases of doubt the sum of the characters will enable us to decide on a proper place for a given genus. It must not be supposed that, because the names suggested by a single set of characters are used to denominate the proposed orders, therefore that set of characters is to be our sole criterion. Such too hasty assumptions are a relic of the days when the immutability of species was an orthodox dogma in biology, and doom to failure any system founded upon them.

For those forms in which the various types of hinge have become harmoniously combined, though in varying proportion contributing to the final mechanism, I have selected the designation of *Teleodesmacea*. These may be regarded as the highest and evolutionally the most perfect in type of hinge, though this perfection shows itself in a variety of forms. Prionodont traces remain with most of them, but are never characteristic of the type.

The three groups I propose to call orders. It is difficult to say whether they can be compared in systematic value with orders in other classes. All that can be said is that these three divisions are discernible in the very compact and homogeneous class which includes them, and it contains no other groups of equal value or significance.

Each order as it now exists contains archaic and modern specialized types. Each indicates a tendency toward an ideal of fitness to the environment, which results in a certain parallelism of minor characters

common to minor groups in each of the three orders. In each (we are coming to regard it as inevitable) certain members show affiliations with members of the other orders. In each there are certain groups which represent a relatively modern specialization carried so far as to be quite peculiar.

Pearliness or a truly nacreous character of shell-substance is a source of weakness. This kind of shell is more fully permeated with animal matter, is more liable to decay and exfoliation, and is more readily drilled by enemies than the aragonitic type of shell-substance which conchologists call porcellanous. The external prismatic layer which usually accompanies a pearly interior layer, as in *Nucula*, *Trigonia*, *Unio*, etc., is very easily disintegrated. The tendency of evolution is to promote the porcellanous type. The older groups (*Prionodesmacea* and *Anomalodesmacea*) contain all the pearly Pelecypods. Among the *Teleodesmacea* there is not a single one. Furthermore, in the two former orders the most specialized and, developmentally, the most modern forms are preferably porcellanous; those which we may reasonably regard as of more ancient type tend to pearliness. For example, in the *Anomalodesmacea* the most striking instances of specialization are the Pholads, *Tubicolæ* and certain *Myacea*, all are earthy, or at least not pearly. The *Anatinacea*, which paleontologically are very ancient, are largely pearly. The *Prionodesmacea* have few porcellanous groups, but those which show this character, such as *Ostrea* and *Pecten*, generally stand at the nearer end of a long line of progressive modification. There are exceptions to this, such as *Tindaria*, in the *Nuculacea*, which is obtrusively porcellanous. *Leda* and *Solenomya*, which retain so many archaic features in their soft parts, have almost lost the pearly layer while still falling short of the porcellanous character conspicuous in most of the *Teleodesmacea*. The Arcas, conspicuously earthy in their shells, are modern in their total characters compared with the pearly Nuculas. Turning to Gastropoda for a moment, we find that *Pleurotomaria*, one of the very earliest types of that class which can be recognized in the now existing fauna, is extremely pearly. On the whole, the relation between the two types of shell-substance if not constant enough to be called a rule, is sufficiently so to be extremely suggestive.

I have already suggested the mechanism of the infolding which resulted in the cartilage and its supporting socket. It is a very difficult task to account for the initiation of all the types of teeth. A few suggestions may be ventured upon.

The radiating or transverse corrugations which we see in ribbed shells are not merely ornamental. They serve to add strength, while they do not increase the weight, as would a corresponding thickening of the shell. A familiar example of the same principle is afforded by the corrugated sheet metal so frequently used by builders. The ends of these ribs impinge on the margin of the shell and crenulate it when the shell is thin. *Crenella* is a notable example. Many *Mytilacea* ex-

hibit a similar structure. These crenulations of the hinge-line and margin are not to be distinguished from nascent teeth, and have frequently been described as such by naturalists. *Nuculocardia* of Orbigny is a well-known instance. The crenulations of the margin are useful in securing a close fit between the closed valves, whether at the cardinal or the basal margin. But they would be more useful at the cardinal margin, because there they would prevent sliding of the valves upon one another before they were completely closed, as do the long teeth of the *Nuculacea*. Hence it is probable that they would be perpetuated and specialized there even if the ribbing disappeared from the exterior of the valves. Great stress arising from friction and pressure resisted would tend toward the thickening, widening, and even buttressing of the cardinal margin until the hinge-plate became developed and sufficiently strong to perform its functions with success. This is one of the ways in which a Prionodont hinge might be initiated.

The Anodont hinge, to reiterate, is a weak and unsatisfactory type. Its defects could hardly continue to exist except in a burrowing and tubicolous generation. To some extent its weakness has been made up for by an asymmetry in the valves, which permits a smaller valve to fit into a larger one. This is a very successful device, as there can be, as long as the larger margin remains unbroken, no question of failure to close the valves. But the projecting margin of the larger valve is a weak feature, much more likely to get fractured than the convex combined edges of two. Once fractured, the mollusk would be defenseless until he could mend the breach Moreover, in moving about—a practice more common with Pelecypods than is generally realized—the asymmetry of the valves would be a nuisance, always tending to shift the traveller out of the line he might desire to take. We find, as we should expect, that the Anodont hinge is persistent with tribes which are borers, tube-dwellers, or burrowers—for the most part very sluggish creatures. In cases where the ventral margins of the valves do not meet, there is, of course, no especial call for a dentiferous hinge, as the valves play the subordinate part of a dorsal shield. This is the case with *Solenomya*, where the ventral hiatus is partly shielded by projecting epidermis. Most of these forms depend apparently quite as much on their activity and the protection of the walls of their burrow as they do on that afforded by the valves of the shell. A reversion of the process is seen in the case of some groups, like *Anodonta*, in which the edentulous hinge is the result of degeneration from a dentiferous type, such as *Unio*. The dentiferous forms retain their teeth in the streams and rivers, where they are subject to numerous casualties and much knocking about, while in the still water and soft mud of silent ponds the teeth vanish and the protective shell reaches its limit of practicable tenuity.

One type of "cardinal" (as opposed to the so-called "lateral") teeth would arise through the modification of an Orthodont or a Prionodont

hinge at one end (as in *Macrodon*), so that part of a row of teeth originally similar would come to differ from the rest. Many *Nuculacea* show stages of such a mode of change.

Another type would arise from the plications of the hinge parallel to and induced by the formation of a fossette or process for the internal cartilage. Such teeth or plications may be observed in most Pelecypods having an internal cartilage. All stages in development of this type may be observed from the barely traceable parallel ridges of *Cuspidaria*, for instance, to the highly specialized cardinal teeth of *Mactra*.

Thus, it will be observed, the teeth called cardinals in Pelecypods are by no means all necessarily homologous, and it is even conceivable that cardinals of both types might come to be united in the same hinge.

The development of lateral teeth from transverse teeth is a very easy process, of which a full exhibit might be made by arranging in a continuous series the valves of selected *Arcacea* and *Nuculacea*. It is probable, however, that not all Orthodont dentition originated in this way. The thickening of the cardinal margin rendered necessary by the stresses involved in the mechanical operation of cardinal teeth or strong external ligaments would render parallel plication of the thickened area along the margin not only easy, but almost inevitable in some cases. The infolding of the edge of the mantle necessarily accompanying the production of a strong specialized socket for an internal cartilage would lead incidentally to occasional deposition of shelly matter in ridges parallel with the longer edges of such sockets. The greater efficiency in guiding the valves to effective closure in proportion to the increased distance from the umbonal region of such interlocking plications would tend through natural selection to the perpetuation of favorable variations and to their gradual removal farther and farther from the beaks until the most useful distance was attained.

When we consider the remarkable uniformity in hinge characters attained by the species with more perfected forms of hinge, through long series of individuals, it seems almost incredible that these results should be brought about by the action of a thin, soft film of secretive tissue which, unaided, could not hold itself erect. It is only when we remember that the result, in the main, is brought about through the action and reaction of certain definite mechanical stresses, propagated through the hard valvular skeleton, and constantly imposed upon the softer tissues, that any adequate reason for the marvelous uniformity presents itself. There are certain groups, such as the *Isocardiidæ*, in which the hinge seems still to be in what may be termed a transition state. With these no such strict uniformity prevails. While the differences are not excessive, yet the hinge of each individual specimen compared with others of the same age will show individual characteristics, and the changes which the hinge undergoes in the same individual between adolescence and old age are greater than one would ordinarily find in

the whole membership of a species, say of the *Veneridæ*, taking all ages, above the larval stage, into account.

We may now proceed to consider the groups of which these orders should be made up.

To the *Anomalodesmacea* I refer the *Anatinacea*, the *Myacea*, the *Ensiphonacea* or *Tubicolæ*, the *Solenomyacea*, and the *Adesmacea*.

In the first three groups or suborders we have forms whose relationship will hardly be questioned, embracing also some instances of the most remarkable specialization of characters. To refer to a few, I may mention *Aspergillum*, *Clavagella*, *Cuspidaria*, and *Poromya*, using these names in their widest sense.

From several characters of the gills and other soft parts paralleled in the *Nuculacea*, *Solenomya* was at first affiliated by me with the Prionodonts.* On mature consideration, while admitting that the last word on this subject has not yet been put on record, I am inclined to believe that this genus is an Anodont which has retained certain archaic features of the soft parts, and represents in the *Anomalodesmacea* a survival analogous to that of the *Nuculacea* among the Prionodonts.

From a very early period the *Solenacea* have been associated with the forms now gathered in this order. Professor Verrill has called attention to the fact that *Tagelus caribæus* and its allies have the organization of *Tellinacea*, and I have removed them to the vicinity of *Psammobia*, in my Check-list of the Marine Shell-bearing Mollusks of the southeastern coast of the United States. (Bull. U. S. Nat. Mus., No. 37.) But are the *Solenidæ* to be left behind? After due consideration I can see no sufficient reason for such a course, and conclude that the united siphons and burrowing habit, with its resulting specialization, do not warrant it. I have therefore excluded them.

In the *Adesmacea* or *Pholadacea* we have the most remarkable specialization of the hinge known in the whole class. The relations of the parts are best understood by a study of the open-shelled forms like *Zirphæa crispata* or *Barnea costata*† and the young of the closed Pholads. In the adult forms of the latter, specialization has proceeded so far that the true relations of the parts are more or less masked. In *Barnea costata* we have the anterior dorsal margin of the valves reflected dorsally until the anterior adductors following the shell pass the axis of motion of the hinge and pull at the short end of the lever, tending to open the valves, instead of to close them. The posterior adductors pull in the normal way and balance the anterior ones. The ligament is reduced to an ineffective film. The cartilage remains as a survival, but reduced to such dimensions as to be practically of no use. Its elastic properties are lost and it merely serves to connect two little processes, the feeble remnants of the original fossettes. An appendage analogous

* Bull. U. S. Nat. Mus., No. 37, p. 26, July, 1889.

† See Proc. Acad. Nat. Sci. Philadelphia for 1889, pp. 274–76.

to and possibly homologous with an original ossiculum has (that view being taken) revolved around the cartilage, taken its place outside of the axis of motion of the hinge, and instead of keeping the valves from crushing each other by checking the closing stress of the adductors as in *Verticordia* or *Bushia*, and other *Anatinacea*, it accomplishes the same end by locking over the reflected edges of the shell on the dorsal surface, acting like the anterior adductors on the short instead of the long arm of the lever, and, as before, in a sense opposed to the action of the adductors. Though greatly specialized and modified, this appendage retains something of the butterfly shape of a broad ossiculum.

An appendage, sometimes called the styliform process or apophysis, with its proximal end attached in the hollow of the beaks, has been homologized by Deshayes with the cardinal teeth. In *Pholas costata* it supports the posterior oral palpus, which is very massive, and some of the internal viscera. If one of the umbonal laminæ of *Callocardia* were detached from its connection with the cardinal margin and allowed to project into the cavity of the valve it would somewhat resemble the apophysis of *Pholas*. But on this view I am at a loss to explain the present connections of this process, about the development of which little or nothing is known. How a cardinal tooth should come to be situated inside the mass of the body would seem to be hard to explain.

The environment of the Pholads is of a very special character, and the modifications of the organization march with the peculiar circumstances under which it exists. To enter into their mutual reactions would take much space and obscure the more general questions to which these remarks are addressed.

It may be added that in this order, as well as the others, the particular constituency of each of the suborders, even the number and scope of the families, must be regarded as tinged with uncertainty from the magnitude of our ignorance. To properly ascertain and correlate the data in regard to the different genera and the families of which they are the members is a labor worthy of devotion, but which will yet require a large amount of original research.

In the *Prionodesmacea* the *Nuculacea* represent an archaic type in many of their features. So far as the hinge is concerned *Arca* (*noæ* and related species) is perhaps the most fully and typically developed instance of Prionodont dentition. The Naiades declare in *Spatha* and *Iridina* their Prionodont origin, traces of which are to be seen in the transverse striation of the teeth of many species of *Unio*, even when lateral teeth have become well developed and pre-eminent. The same is true of *Trigonia*, which has many points in common with the Naiades and may perhaps be the descendant of a common ancestry. To the latter immediately *Mulleria* bears such a relation in its adult state as do the Monomyarian *Pecten* and *Ostrea* to the rest of the *Prionodesmacea* as a whole. The Prionodont character of the *Mytilacea* will not be

questioned. Through them we pass to the *Pectinacea*, in which in *Spondylus* we have the finest instance of a Prionodont hinge with few teeth, as *Arca* is of one with many teeth.

The original transverse grooving of the hinge is visible on the very young valves of many species of *Pecten*, *Janira*, etc. The *Ostracea* are the last term of specialization in this line; the *Anomiacea* are brought in by the total of their characters, though so far modified as to indicate little, by the hinge, of what I suppose to be their origin. Above all it must be admitted that the *Monomyaria* and *Heteromyaria* represent not fundamental types of structure but special modifications, though some of them are geologically ancient.

The remaining forms representing the march of progress toward a mechanical perfection in hinge characters, though retaining traces (as in the striated teeth of some Mactras) of Prionodont ancestry which once dominated the dentition, constitute the order *Teleodesmacea*.

In the main, in the combination of hinge characters which they present, the most striking features are the effective manner in which the orthodont laterals and prionodont cardinal teeth are subordinated to and supplement each other's action, the occasional introduction of the internal cartilage in happy combination with the others, and the general absence of a prismatic layer and of nacre in the shell-structure and of archaic characters in the soft parts.

It is a question whether the *Rudistes* are to be considered a group apart, or, like the *Pholadacea* among the *Anomalodesmacea*, merely an erratic special development of forms related to the *Chamacea*. Leaving the question to be settled by the special studies its difficulties call for, I conclude this paper with a tabular view of the orders and suborders into which the class is divided. One group, the *Leptonacea*, stands much in need of thorough study, without which its component families and even its permanent standing must remain doubtful. With our present knowledge it is yet impossible to determine the number of families of which each suborder should be composed, or even how many groups are entitled to rank as families. But in the major groups I feel a certain amount of confidence that the present arrangement is in most respects more harmonious and in accord with the balance of characters than any of the systematic arrangements of the class which have been hitherto proposed.

SUPPLEMENTARY NOTE.—When I first began to consider the relations of the teeth and other parts of the hinge I naturally remembered the brief abstract of the important paper on the hinge of bivalves by M. Neumayr, which I had seen in the Zoological Record for 1883. I intentionally deferred a careful perusal of Neumayr's essay until I had entirely completed my own. Then a careful examination of his original afforded me great pleasure. It showed that in the matter of the influence of ribbing in promoting nascence of teeth; in the discrimination

of lateral plications, arising in connection with the fossette of the cartilage from the true cardinal teeth; in the influence of the environment on the degeneration of hinge characters; in the estimate of the characters of the primitive bivalves, and some minor points, we had arrived independently at the same conclusions, and even illustrated them by identical or nearly identical examples. This is certainly strong presumptive evidence of the correctness of those inferences. In the points in which we differ it seems to me that the differences arise from the fact that Neumayr has approached the subject more from the paleontological stand-point, and has less considered or has given less weight to biological considerations, not imprinted on the shell; while in my own case, from the nature of my previous studies, I have been led to attack the problem from the other side. Recent investigations, available only since the date of Neumayr's paper, have thrown much light on the inosculation of characters not before known to interlace. Neumayr, also, from my stand-point, has insufficiently grasped the importance of the different processes involved in the production of the internal cartilage and its shelly coefficients on the one hand and the denticulation of the hinge margin on the other. These two processes, though they must often have proceeded simultaneously in the same genus, were not necessarily connected, except in so far as by resulting stresses each might react on the hinge-product of the other. So instead of having a Desmodont type of hinge as opposed to a Prionodont, and, as Neumayr would say, a Heterodont (Teleodont) type, we may have either an Anodont (Paleoconch), a Prionodont (Taxodont), or a Teleodont (Heterodont) type of hinge, either with or without an internal cartilage and its accessories.

By the elaboration of this view, as attempted in the foregoing discussion, it seems to me the discrepancies so evident in Neumayr's system have been avoided, the types of hinges assigned their proper weight in the system, while those biological relations which are not fully reflected in the shelly parts have not been slighted; though inevitably numerous improvements in detail will suggest themselves to students, or be effected by a future expansion of our knowledge.

As regards the Rudistes, if, as claimed by Woodward and others, they possessed an internal cartilage, it is probable that they must form a specially modified and extraordinary ramification of the *Chamacea*. If, however, as is claimed by some authors, there was no internal cartilage or external ligament, no hinge, properly speaking, and the smaller valve simply rose and fell vertically under the control of adductor muscles, guided by interlocking processes, it is evident that this would establish an inter-relation between the valves, unlike anything among the Pelecypods, and only comparable, perhaps, with that of certain operculated corals. In the latter case the Rudistes would have to be regarded as ranking at least among the subclasses, if as Mollusca at all. My own impressions are that the first-mentioned view is the more probably correct one.

The opinion is occasionally expressed in scientific literature that the shell is a "mere secretion of the mantle." This usually proceeds from some person who has not well studied the molluscan shell, or who is of the age when one knows more than at any subsequent period.

Such a statement is one of those half-truths which are more dangerous than pure error, since the ballast of truth they contain will enable the error to navigate some distance, while the unfreighted error would capsize at once.

The shell is in one sense the product of secretion from the mantle, as the mammalian tooth is derived from the ectoderm of the jaw, or the skeleton from the periosteum and cartilages. Both are that and much more. It would be as reasonable to say that a steam-boiler, in process of construction, is the product of the boy inside who holds the rivet-heads, as to claim that the shell has no more significance than is implied in the term "secretion of the mantle."

The original theoretic protoconch may have been so, but as soon as it came into being its development was governed by the physical forces impinging upon it from all sides, and through it influencing the growth and structure of the soft parts beneath. The Gastropod shell is the result of the action and reaction between the physical forces of the environment and the evolutionary tendencies of the organic individual. In the Pelecypod we have the mechanical stresses and reactions of one valve upon the other added to the category of influences. To a considerable extent it is doubtless as true that the animal is molded by its shell as it is that the shell is shaped by the soft parts of the animal. This results in that correlation of structure which has enabled students to, in the main, correctly judge of the relations of mollusks by their shell characters, when the latter were intelligently studied and properly appreciated.

Class PELECYPODA.

I. Order ANOMALODESMACEA.

Suborders.

1. Solenomyacea.
2. Anatinacea.
3. Myacea.
4. Ensiphonacea.
5. Adesmacea.

II. Order PRIONODESMACEA.

Suborders.

1. Nuculacea.
2. Arcacea.
3. Trigoniacea.
4. Naiadacea.
5. Mytilacea.
6. Pectinacea.
7. Anomiacea.
8. Ostracea.

III. Order TELEODESMACEA.

Suborders.

1. Tellinacea.
2. Solenacea.
3. Mactracea.
4. Cardiacea.
5. Carditacea.
6. Chamacea.
7. Tridacnacea.
8. Leptonacea?
9. Lucinacea.
10. Isocardiacea?
11. Veneracea.

? Rudista.

DESCRIPTIONS OF THE SPECIES.

Order PRIONODESMACEA.

Suborder PECTINACEA.

Family PECTINIDÆ.

Genus **PECTEN** Müller.

Pecten glyptus Verrill.

Plate VIII, Figs. 2, 3.

Pecten glyptus Verrill, Trans. Conn. Acad. Sci., v, p. 580, July, 1882.
Pecten Tryoni Dall, Bull. Mus. Comp. Zoölogy, XVIII, p. 438, June, 1889.

HAB.—U. S. Fish Commission Station 2602, north latitude 34° 38′, west longitude 75° 33′, off the coast of North Carolina in 124 fathoms, sand; bottom temperature 61° F.; and off Martha's Vineyard in 85 to 120 fathoms.

Shell large, thin, both valves about equally convex, right valve more brilliantly colored; ears subequal, hinge line straight; beaks small, pointed, not prominent; orb of the shell somewhat oblique, anterior portion produced downward and forward, margin simple, entire, sharp; sculpture of wide little-elevated ribs, about seventeen in number, each with a central keel which is sharp and slightly serrate over two-thirds of the surface but becomes obsolete toward the margin; this keel is colored more deeply than the rest of the rib, and the color may be alternately concentrated at the prominences and fainter between them. In the specimens observed it is either deep rose color or a warm orange-brown, fading gradually on each side of the keel of the ribs, while the interspaces are pale or white, with faint narrow radiating lines of the color; on the right valve, except along the hinge line, the auricles are pale; the minute sculpture consists, on this valve, of fine radiating grooves, about a dozen between the carinæ of each pair of ribs, across which are carried in fine scallops sharp little-elevated lamellæ; these lamellæ are easily felt, but visible only with some magnification; the left valve shows (in a rose-colored specimen) very little color, and that a mottled orange-brown confined chiefly to the ribs of the apical third; the ribs

are keeled for a shorter distance than in the right valve, are generally fainter, while the microscopic sculpture is composed only of fine concentric incremental lines which have a silky appearance; the hinge line of the left valve slightly overrides that of the other valve and is serrate by fine transverse scales; the ears are subequal, the byssal notch shallow and rounded, without a pectinium; there are a few elevated radiating lines on these ears; internally the hinge line is nearly smooth, the cartilage pit small and narrow, two short, stout auricular liræ radiate from it; the interior of the shell is white; the interspaces between the external ribs are defined by fourteen or fifteen pairs of elevated liræ strongest distally and ending close to the margin. Maximum altitude of shell 60.0; maximum longitude 60.0; longitude of hinge line 25.0; diameter of closed valves 11.0 mm.

This fine species was not at first recognized from Professor Verrill's rather brief diagnosis, which was not accompanied by a figure; and in this way a new name was applied to the species in a preliminary notice of it. More mature consideration, though without comparison of specimens, leads me to the belief that Professor Verrill's name applies to the shell before me.

Although a ribbed species, the internal liræ are very much like those of *Amusium*, and this shell adds one more to the links which connect the various groups of the old genus *Pecten* together. A careful comparison has been made with European species, and there can be no doubt of the distinctness of this from any of them.

Pecten exasperatus Sowerby.

The collections made on the voyage contain a valve of *Pecten exasperatus* Sowerby (*P. fuscopurpureus* Conrad) from Station 2762, in 59 fathoms, mud, off Rio Janeiro. This considerably extends the southward range of this species beyond the localities previously known.

Pecten effluens Dall.

Plate xi, Fig. 9.

Pecten effluens Dall, Bull. Mus. Comp. Zoöl., xii, p. 219, September, 1886.

This hitherto unfigured and very delicate little species was originally dredged off Havana by Sigsbee in 127 fathoms. Since then it has been obtained in 300 fathoms off Cape San Antonio, Cuba, by Dr. Rush and at U. S. Fish Commission Station 2646, in 85 fathoms, sand, off Cape Florida.

The valves may be pale or even bright lemon-yellow, orange or scarlet, always somewhat translucent. The surface presents an excellent example of the microscopic *Camptonectes* striation. The specimen figured is 26.0 mm in length.

Section PSEUDAMUSIUM H. & A. Adams.

Pecten (Pseudamusium) strigillatum Dall.

Plate XI, Fig. 2.

Pseudamusium strigillatum Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 438, June, 1889.

Shell small, white, thin, rounded, with a straight hinge-margin; left valve inflated, the posterior auricle narrow, separated by a deep narrow byssal notch from the rest of the margin; right valve flatter, the posterior auricle well defined, small; both valves similarly sculptured with nearly equidistant thin lamellæ, which, when perfect, curve forward and touch the rising curve of the next succeeding lamella; an absolutely perfect specimen would therefore present a series of equal, smooth, concentric waves, falling almost vertically from the anterior hinge margin and curving in a subcircular sweep around to the depression which marks off the posterior auricle in either valve. Practically, however, the fragile lamellæ never retain more than traces of their perfect state and present a series of very sharp elevated concentric laminæ following the lines of growth and separated by narrow nearly equal intervals, averaging on the whole four or five to the length of a millimeter, radially measured; the umbones are small and prominent, reaching slightly above the cardinal margin; the interior is smooth and polished; there is no radiating sculpture; the ligament is small and subcentral; there are no transverse rugæ on the hinge margin, and no internal liræ. Maximum altitude of the shell 9; maximum latitude 8.5; diameter, 4.4mm.

HAB.—U. S. Fish Commission Station 2383, in 1,181 fathoms, mud, between the delta of the Mississippi and Cedar Keys, Gulf of Mexico; bottom temperature 39°.8 F.; Station 2751, off St. Kitts, in 687 fathoms, ooze; and 2760, 90 miles north of Ceara, Brazil, in 1,019 fathoms, temperatures 39°.9 and 39°.4, respectively.

This very simple and yet very characteristic little species seems to stand in need of no comparisons, as it is not sufficiently similar to be easily mistaken for any of the known species.

Family LIMIDÆ.

Genus LIMA Bruguière.

Subgenus LIMATULA S. Wood.

Limatula setifera Dall.

Plate XIV, Fig. 10.

Limatula setifera Dall, Bull. Mus. Comp. Zoöl., XII, p. 224, 1886.

HAB.—From North Carolina to Barbados in 50 to 450 fathoms, collected by the *Albatross* at Stations 2612 and 2646.

Genus **LIMÆA** Bronn.

Limæa Bronniana Dall.

Plate XIV, Fig. 9.

Limæa Bronniana Dall, Bull. Mus. Comp. Zoöl., XII, p. 226, 1886.

HAB.—North Carolina to Barbados in 15 to 804 fathoms, U. S. Fish Commission Stations 2596, 2612, and 2619 being among the localities.

Suborder **MYTILACEA.**

Family MYTILIDÆ.

Genus CRENELLA Brown.

Crenella (decussata var.?) divaricata Orbigny.

Crenella decussata (Montagu) Dall, Bull. Mus. Comp. Zoöl., IX, p. 116; XII, p. 235, 1886.

Nuculocardia divaricata Orbigny, Moll. Cuba, II, p. 311, Pl. XXVII Figs. 56-59, 1845.

This little shell—described from the Antilles by Orbigny, and indistinguishable from specimens of *C. decussata* of the same size, except that it is usually whiter—never reaches the size of northern specimens of *C. decussata*. The latter is found as far south as Catalina Island, off the coast of Santa Barbara County, California. The presence of a fresh specimen of *C. divaricata* containing the animal, in dredgings at Station 2805, in 51 fathoms, mud, Panama Bay, was therefore not altogether surprising. It is the first record of the Antillean form on the west coast of America and adds to the probabilities of its being merely a tropical race of *C. decussata*.

Suborder **NUCULACEA.**

Family LEDIDÆ.

Genus MALLETIA Desmoulins.

Malletia goniura sp. nov.

Plate X, Fig. 10.

Shell small, rather full, with a brilliantly polished olivaceous epidermis, and faint sculpture of incremental lines; umbones not prominent; anterior end rounded; base nearly straight; posterior extremity bluntly truncate with a double flexure, caused by two well-marked ridges extending from the beaks to the extremity of the shell; lunule and escutcheon linear or none; ligament external, short, black; hinge line straight behind the beaks, descending slightly in front of them, with nineteen anterior and twenty-five posterior, small, short V-shaped teeth, the two series separated by a short edentulous space; interior polished, slightly iridescent; muscular scars rather large, faint; the pal-

lial line obscure, with a large rounded sinus; margins simple, smooth. Longitude of shell 15.5; altitude, 9; diameter, 6mm.

HAB.—U. S Fish Commission Station 2793, off the coast of Ecuador in 741 fathoms, mud; bottom temperature 38°.4 F.

This species is most like *M. arruana* Smith from the Arru Islands, but that species has the upper posterior corner beveled off and no longer angular, which makes a marked difference in the outline of the shell. *M. obtusa*, which has somewhat the same form, wants the marked furrows of the posterior end of this species.

Malletia (Tindaria?) æolata sp. nov.

Shell small, thickish, pale straw color, subrectangular; surface smooth and polished at the umbones, gradually becoming strongly concentrically ridged with rounded narrow ridges separated by mostly linear interspaces; anterior end longer, nearly evenly rounded, a little produced below; posterior end shorter, longest above, obliquely truncate with a concave wave between the upper point and the beginning of the little-curved base; beaks full, not prominent; no visible lunule or escutcheon; hinge margin broad, with eleven anterior and eight posterior W-shaped teeth, of which four or five on each side are not developed; ligament central under the beaks, small, wholly external to the tooth line; interior polished, scars and pallial line rather obscure. Maximum longitude 4.5; altitude 3; diameter 2.5; vertical of beaks from anterior end 2.8mm.

HAB.—Station 2754, in 880 fathoms, ooze, east from Tobago; temperature 37°.9 F.

Nearest to the young of *M. australis* or the adult *M. excisa*, but of different form from the latter, stouter and more rectangular and less deeply notched.

Malletia (Tindaria) amabilis Dall.

Malletia (Tindaria) amabilis Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 438, Pl. XL, Fig. 8, June, 1889.

This species was obtained from Stations 2751 and 2754, in 607 fathoms, ooze, off St. Kitts, and 880 fathoms, ooze, east from Tobago; temperatures 39°.9 and 37°.9 F., respectively.

Malletia (Tindaria) agathida sp. nov.

Plate XIII, Fig. 10.

Shell small, stout, white, with prominent umbones; produced and rounded before, shorter and pointed behind, with close, strong, subequal, uniform concentric ridges; base rounded, slightly concavely waved in front of the angle of the rostrum, corresponding to a marked depression in front of an equally prominent ridge which extends from

the umbo; the concentric ridges are about equal to their interspaces; there is a pale yellow concentrically finely wrinkled epidermis; the tips of the umbones are full, smooth, and polished; there is a lanceolate, smoothish lunule bounded by an obscure ridge, and a shorter and narrower escutcheon bounded by a faint ridge, outside of which is a faint depression; on either side of the beaks is a narrow, flattened area, recalling that of *Limopsis*, but much smaller and narrower; in the middle of this, just under the beaks, is a very small socket for the ligament, which is wholly external to the line of the teeth, just as in *Palæoneilo;* there are eleven developed and three obsolete anterior teeth and about twelve posterior teeth, of which two or three are very small; the two sets are separated by a very narrow, smooth space, but there is no cartilage; the muscular scars are deep, the pallial line obscure, the margin simple, and the valves rather thick; maximum longitude of shell 5.5; maximum altitude 4.5; diameter 3.1^{mm}; the beaks are over a point on the line of maximum length, which is 3.25^{mm} from the anterior end.

HAB.—Station 2751, south from St. Kitts, in 687 fathoms; and 2754, east from Tobago, in 880 fathoms; temperatures 37°.9 to 39°.9 F.

This species has much the outline of *Modiolarca exilis* H. and A. Adams (see Zool. Kerguelen Id., Mollusca, by E. A. Smith, Transit of Venus Expedition, Zool., Plate IX, Fig. 24), and resembles in stoutness and sculpture *Leda Brookei* Hanley, as figured in the Thesaurus.

Malletia (Tindaria) acinula sp. nov.

Plate XIII, Fig. 4.

Shell small, subquadrangular, white, with the anterior end shortest, and the surface sculptured with strong, close, subequal, rounded concentric waves, separated by linear interspaces; base produced in the middle, rounded; anterior end short, rounded; posterior end longer, with a rounded point, but not rostrate; beaks apical, but not prominent; lunule and escutcheon subequal, small, narrow, impressed, rather short, with no bounding elevated line or groove; ligament small, longer than high, directly under the beaks, external to the tooth line, and visible externally in the closed shell; anterior part of the hinge with eight, posterior part with ten, V-shaped teeth, of which two or three on each side are very small; scars well marked, impressed; pallial line obscure, arcuated in front of the posterior adductor; margin of the valves plain, interior polished, shell rather thick; maximum longitude of shell 5.0; maximum altitude, 4.2; diameter 3.5; distance of vertical, drawn from the beaks, from anterior end, 1.5^{mm}.

HAB.—With the last and also at Station 2760, in 1,019 fathoms, brown clay, ninety miles north from Ceara, Brazil; temperature 39°.4 F.

This shell has much the outline of *Leda quadrangularis* Dall, but is proportionally higher and shorter, with more prominent and regular concentric sculpture.

Malletia (Tindaria) virens sp. nov

Plate XIII, Fig. 3.

Shell small, inflated, thin, closely, minutely, concentrically ridged, with a green or olive-green epidermis; anterior end shorter; base evenly rounded, beaks full but not prominent; outline of the shell recalling *Callista;* anterior end evenly rounded, posterior produced, with a very obtuse rounded point, not rostrate; ligament under the beaks, but extending further behind than in front of them, wholly external to the tooth line, which is continuous below it; anterior teeth eight, posterior ten, with three or four undeveloped additional teeth under the beaks on each side; teeth prong-shaped; scars obscure, pallial line invisible; shell very thin, cardinal margin very weak and narrow. Maximum longitude 4.5; altitude 3.5; diameter 2.5; vertical of the beaks, 2mm from the front margin.

HAB.—Stations 2781, 2782, 2783, and 2785, in 122 to 449 fathoms, mud, on the west coast of Patagonia; temperatures 47° to 50° F.

This species is exceptional for its thin shell and very green epidermis I have not been able to distinguish any lunular area or escutcheon.

Genus **YOLDIA** Mörch.

Yoldia scapania sp. nov.

Plate XIII, Fig. 6.

Shell elongated, polished, smooth, whitish with a pale yellowish epidermis, the beaks very inconspicuous, hardly raised above the level of the slightly angulated hinge-line; base nearly straight; the anterior end rounded above, more oblique toward the base; the beaks slightly more than one-third of the way from the anterior to the posterior end; posterior end bluntly rounded as in a *Siliqua;* interior smooth, white, with a deep rounded pallial sinus and rather large rounded muscular scars; hinge with about twenty-eight very small V-shaped posterior and twenty-five anterior teeth, the anterior ones being crowded more closely; there is a greater difference in the length of the hinge-line on each side of the ligament pit than the numbers would imply; ligament wide, low, subtriangular, wholly internal; margins of the valves smooth, sharp; maximum longitude of shell 18.25; altitude 9; diameter 5.6mm.

HAB.—U. S. Fish Commission Station 2762, east of Rio Janeiro, in 59 fathoms, mud; bottom temperature 57° F.

This species is remarkably soleniform, gaping slightly at either end, mostly at the posterior end; it is very evenly inflated and the beaks are so inconspicuous as to be practically almost indiscernible. It is most like *Y. solenoides* Dall, which is smaller, has the posterior end less blunt and slightly narrower; is a smaller shell, with more central umbones and a few concentric grooves near the base. In the present

species, as in the *Y. solenoides*, there is a narrow lunule and escutcheon bounded by a shallow groove, but in the latter this groove indents the anterior margin, while in *Y. scapania* it does not. There are a few obscure radiations, and the incremental lines are more conspicuous toward the middle basal part, but the sculpture, if such it can be called, is hardly noticeable. The teeth are larger in *Y. solenoides*, though it is a much smaller shell.

Yoldia pompholyx Dall.

Plate XIII, Fig. 8.

Yoldia pompholyx Dall, Bull. U. S. Nat. Mus. No. 37, p. 44, No. 151, 1889.

Shell small, rounded, polished, inflated, smooth except for incremental lines, covered with an extremely thin grayish green epidermis; subtranslucent when fresh, ashy or white when weathered; a pair of very faint ridges in front of and behind the beaks indistinctly indicate areas corresponding to lunule and escutcheon; beaks rounded, inconspicuous; shell entirely closed when the valves are shut; ligament nearly central, its upper surface slightly exposed externally between the valves; interior smooth; hinge-line narrow, roundly arched with seven anterior and eight posterior teeth of normal form and a well-marked pit or fossette central between the beaks; margins smooth; maximum longitude of largest valve 4mm; longitude of another (pair) 3.5; altitude 3; diameter 2mm.

HAB.—U. S. Fish Commission Station 2668, in 294 fathoms, gravel, off Fernandina, Fla.; temperature 46°.3 F. Also by Dr. W. H. Rush, U. S. Navy, off Havana in 1,024 fathoms, mud, and off the Fowey Rocks, east Florida, in 205 fathoms.

This curious little species has much the external form of Jeffreys' *Glomus*, but has the regular hinge of the small rounded Yoldias.

Genus LEDA Schumacher.

Leda cestrota sp. nov.

Plate XIII, Fig. 7.

Shell thin, compressed, elongated, rostrated, translucent white, with a pale gray or olive epidermis, which is generally mostly lost; umbones hardly raised above the hinge-line, pointed, inconspicuous, compressed; base forming a shallow reversed arch, meeting the anterior curve of the upper edge in a rounded point; posterior upper margin nearly straight, becoming slightly concave toward the end of the rostrum; rostrum longest above, obliquely truncate, its basal margin slightly concave, then swelling into the curve of the base; sculpture of numerous thin, sharp, elevated concentric lamellæ, prominent anteriorly and near the base, less so on the cheeks of the valves and obsolete near the rostrum;

radiating sculpture of a ridge bounding the lunule over which the lamellæ pass, becoming finer and then obsolete toward the pouting cardinal margin; also, a ridge bounding the escutcheon, and a second less obvious thread from the beak of each valve to the lower angle of the rostrum; the former shows by small elevated, pointed scales the influence of the lamellæ, slight traces of which also appear on the second ridge; the escutcheon is long, narrow, and smooth, with pouting lips, and there are no developed lamellæ between the ridges outside of it; shell internally polished, showing no scars; there is no mesial ridge in the rostrum; cartilage large, black, triangular, posteriorly inclined, wholly internal; teeth small, about forty anterior and fifty posterior to the beaks, of which seven to nine on each side are undeveloped; on the anterior side, between the anterior margin of the fossette and the tooth-line proper, is a flat space over which these undeveloped teeth are widened out as transverse, but little elevated, ridges; maximum longitude of shell, 25.5; longitude from vertical of beaks to end of rostrum, 17; maximum altitude of shell, 8.75; diameter, 3.75mm.

Hab.—Station 2145, near Colon (Aspinwall), in 25 fathoms, mud.

This is nearest *L. concinna* Adams, from New Zealand, but is proportionally more elongated and pointed posteriorly, and more compressed.

Leda platessa sp. nov.

Shell thin, flat, smooth, whitish, nearly straight; sculpture only of faint incremental lines; epidermis pale straw-color, translucent, polished; beaks small, bulbous, but inconspicuous, or hardly elevated above the hinge-line; lunule so narrow as to be obsolete; escutcheon extremely narrow, long, bordered by a faint thread, below which is a still fainter one; base arcuate; anterior end evenly rounded, short; posterior end straight, squarely, not obliquely, rounded-truncate; interior polished, rostrum with a mesial septum most elevated distally, nearly central; fossette narrow, elongated, parallel with the cardinal margin; teeth very small, anterior series with four undeveloped and seven elevated teeth; posterior series with about twenty-five developed and eight or nine (?) undeveloped arched teeth; interior of shell polished, not showing the scars. Maximum longitude of shell 10.3; altitude 4.4; diameter 2; vertical of the beaks from anterior end 3.25mm.

Hab.—Station 2762, east from Rio Janeiro, in 59 fathoms, mud; temperature 57° F.

The nearest relative of this shell is *Leda Carpenteri* Dall, from the eastern coast of the United States and the Antilles. The latter has the rostrum much more slender and more recurved, the lunule, and especially the escutcheon, wider and better defined, and the curve of the anterior end more pointed in the middle. The central part of the base below the beaks is also, in harmony with the general curvature of the shell, proportionally more produced. The number of teeth on the

hinge-line is smaller, the fossette shorter and wider, and the rostral septem more dorsally situated.

This species recalls, to some extent, *Leda Bushiana* Verrill, but that species is more elevated and has sparse, prominent concentric lamellæ over part of its surface.

Leda pontonia sp. nov.

Plate XIII, Fig. 5*b*.

Shell stout, strong, inflated, with a thin ochre-yellow or pale olive epidermis and recurved, pointed, posterior end; beaks approximate, full, incurved, not high, slightly anterior; anterior end evenly rounded, produced; posterior end vertically compressed, produced, recurved, pointed but not rostrate; base evenly arcuate; radiating sculpture of occasional faint microscopic striations near the ends of the shell, usually absent, and a marked but not sharp-edged ridge in each valve, extending from the beak to the posterior point and bounding the posterior dorsal area in each valve; concentric sculpture of numerous fine regular continuous rounded threads, separated by narrower grooves; this sculpture, however, becomes suddenly obsolete on the cheeks of the valves and in front of the ridges above mentioned; the threads are stronger above and behind the ridges, but fade out in a central cordate area which, though not impressed, may be taken to represent the escutcheon; there is no obvious lunule; interior polished, muscular and pallial scars faint, the former small; pallial sinus shallow, small, and terminal; teeth V-shaped, anterior sixteen, posterior thirteen, all developed; fossette internal, deep set, subtriangular, short; maximum longitude of shell 14.5; altitude 10; diameter 6.8; vertical of beaks behind the anterior end 6.25mm.

HAB.—Stations 2807 and 2808, in 812 and 634 fathoms, mud and sand, near the Galapagos Islands, Pacific Ocean; temperatures 38°.4 and 40° F.

This is a remarkably plain, stout, and simple species, notable for its recurved tip, broad, flattened posterior dorsal area and arcuate base. It has somewhat the form of *L. chuva* Gray, but is proportionally longer and has a different sculpture.

Family NUCULIDÆ.

Genus **NUCULA** Lamarck.

Nucula Verrillii Dall.

Plate XIV, Fig. 4.

Nucula Verrillii Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 248, 1886.

Nucula trigona Verrill, Trans. Conn. Acad., VI, p. 438, 1885, not of Bronn, 1849, or Seguenza, 1877.

HAB.—Off Nantucket at Station 2194 in 1,440 fathoms, and off the coast of Maryland at Stations 2228 and 2229 in 1,582 and 1,423 fathoms

(Verrill). Also at Station 2754 in north latitude 11° 40′ and west longitude 58° 33′ east from Tobago in 880 fathoms, ooze, and Station 2760, 90 miles north from Ceara, Brazil, in south latitude 12° 7′ and west longitude 37° 17′ in 1,019 fathoms, broken coral bottom; temperatures 37°.9 to 39°.4 F.

This species recalls the Miocene *N. dolabella* H. C. Lea from Virginia.

Nucula crenulata A. Adams.

Nucula crenulata A. Adams, P. Z. S., 1860, p. 52.
N. culebrensis E. A. Smith, Chall. Rep., Lamellibr, p. 228, Pl. XVIII, Figs. 11, 11*a*, 1885.
N. crenulata Dall, Bull. Mus. Comp. Zoöl., IX, p. 123, 1881, XII, p. 247, Pl. VII, Fig. 2, 1886.

HAB.—Gulf of Mexico and Antilles, also Station 2785, in south latitude 48° 9′ and west longitude 74° 36′, on the west coast of Patagonia in 449 fathoms, mud; temperature 46°.9 F.

This locality greatly increases the southward range of this species and carries it into the Pacific. The identification seems satisfactory.

Nucula cancellata Jeffreys.

Nucula reticulata Jeffreys, 1876, not of Hinds.
N. cancellata Jeffreys, P. Z. S., 1881, p. 951. Verrill, Trans. Conn. Acad., VI, 231, 1884.

HAB.—Europe, Azores, New England, near Georges' Banks and southward to Martha's Vineyard. Also at Station 2754, east from Tobago, in 880 fathoms, ooze, temperature 37°.9, north latitude 11° 40′ and west longitude 58° 33′.

The known southward extension of this species is greatly enlarged by the specimens dredged as above mentioned.

Nucula cymella Dall.

Plate XIII, Fig. 1.

Nucula cymella Dall, Bull. Mus. Comp. Zoöl., XII, p. 246, 1886.

HAB.—Yucatan Strait in 540 fathoms. Florida Straits. Also at Station 2135, in 250 fathoms, hard coral bottom, south of Cuba, in latitude 19° 56′ north and longitude 75° 47′ west; Station 2754, east from Tobago, in 880 fathoms; and Station 2760, 90 miles northward from Ceara, Brazil, in south latitude 12° 7′ and west longitude 37° 17′, in 1,019 fathoms, broken coral; temperature 38°.4 F.

The last station extends the known range of this species nearly 2,000 miles to the southward of previous stations.

Nucula callicredemna sp. nov.

Plate XIII, Fig. 9.

Shell rather large when adult, thin, compressed, with a polished yellowish-olive uniform epidermis, radiating and concentric sculpture; form of adult ovoid, recalling *Nucula niponica* E. A. Smith (Chall. Rep.,

Lamellibranchs, Pl. XVIII, Fig. 8) but proportionally higher; beaks prominent, recurved, frequently eroded; radiating sculpture of numerous fine, rather distant, sharp threads, more crowded near the beaks, broader and less sharp near the anterior and posterior basal margin, not dichotomous; concentric sculpture of narrow, rather short, discontinuous and irregularly placed ripples, strongest and more irregular near the base, more crowded and regular and much less prominent near the beaks, sometimes altogether or nearly absent, especially in the young; lunular region impressed but not circumscribed, rather short and broad, with a shallow flexure just outside of it; escutcheon long, narrow, obscure; interior nacreous, polished, the basal margin closely, deeply, and sharply fluted, at all ages; anterior tooth-line concavely curved with nine teeth, all developed; posterior series convexly moderately curved with nineteen developed teeth rather conical and sparsely set; fossette shaped like the operculum of *Fusus*, curved in harmony with the dorsal margin, wholly internal; maximum longitude of adult 12.5; altitude 9; diameter 5.5; vertical of beaks from anterior end 2.75^{mm}. Young shell, longitude 7.25; altitude, 5.5; diameter 3.5^{mm}.

HAB.—Station 2754, east of Tobago, in 880 fathoms, ooze; temperature 37°.9 F.

This elegant shell is quite noticeable for its thin and light character, its continuous fine sharp radii, and its narrow though not flattened form. The young are more triangular, smoother, and proportionally more plump, some of them recalling at first sight the adult *N. Verrillii* Dall. The internal fluting is particularly marked and sharp and has suggested the specific name. There is no species which closely resembles this form, though it belongs to the group which contains *N. crenulata*, *cancellata*, *decussata*, etc.

Suborder ARCACEA.

Family ARCIDÆ.

Genus ARCA Linné.

Arca jamaicensis Gmelin.

Arca barbata Linné.

The above species were collected at the Abrolhos Islands off the coast of Brazil near Bahia.

Arca Noæ Linné.

Arca reticulata Gmelin.

Arca Adamsi Shuttleworth.

The three preceding species were collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom, about 419 miles south of the equator. *A. reticulata* and *A. Adamsi* were also obtained at the Abrolhos Islands.

Arca glomerula Dall.

A. glomerula Dall, Bull. Mus. Comp. Zoöl., IX, p. 121, 1881; XII, p. 241, Pl. VIII, Figs. 9, 9*a*, 1886.
A. inæquisculpta E. A. Smith, Chall. Rep., Lam., p. 267, Pl. XVII, Figs. 8*a*–8*c*, 1885.

This species was obtained at Station 2750, in 497 fathoms, sand, off the island of St. Bartholomew, West Indies; temperature 44°.4.

Arca pectunculoides var. orbiculata Dall.

A. var. *orbiculata* Dall, op. cit., IX, p. 121, 1881; XII, p. 240, Pl. VIII, Fig. 5, 1886.

This species was obtained at Station 2751 in 687 fathoms, globigerina ooze, south of St. Kitts, West Indies; temperature 39°.9 F.

Genus **PECTUNCULUS** Lamarck.

Pectunculus undatus Linné.

P. undatus (Linné) Dall, Bull. Mus. Comp. Zoöl., XII, p. 238, 1886.

This species was obtained at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom. South of this station where the genus occurred it was represented by the Patagonian form which occurs on both coasts of the southern part of South America.

Order TELEODESMACEA.

Suborder CARDITACEA.

Family CRASSATELLIDÆ.

Genus **CRASSATELLA** Lamarck.

Crassatella floridana Dall.

Plate XI, Fig. 4.

Crassatella floridana Dall, Bull. Mus. Comp. Zoöl., IX, p. 131, 1881; XII, p. 256, Pl. VI, Fig. 12, 1886.

HAB.—Gulf of Mexico and southeastern coasts of the United States at U. S. Fish Commission Stations 2372, 2409, 2410, 2595, 2596, 2597, 2598, 2604, 2606, 2607, 2608, 2610, and among the Florida Keys in 3 fathoms, living, by Lieut. J. F. Moser, U. S. Navy. The species ranges in depth from 3 to 50 fathoms, is commonest in about 25 fathoms, and has been found in temperatures of 73°.5 to 80° F.

This fine species was originally described and figured from a young shell. The adults obtained as above by the U. S. Fish Commission enable me to figure the adult. The largest valve obtained measured 78^{mm} long and 57^{mm} high. The complete shell must have had a diameter of about 31^{mm}. When fresh it is covered with a bright reddish brown epidermis, which becomes fibrous after death and maceration or in very aged specimens. The margins are smooth at all ages. In aged specimens the outside longitudinal grooving becomes obsolete near the mar-

gin. The interior in fresh specimens is pink, white, or pinkish chocolate, darker behind; sometimes of a rich salmon color. The species does not agree with any of Conrad's Tertiary species, and is entirely distinct from the *C. antillarum* Reeve, the only other recent species of the true Crassatellas yet known to inhabit this region. It has not yet been found in the southeastern Antilles.

Family ASTARTIDÆ.

Genus **CIRCE** Schumacher.

Subgenus GOULDIA C. B. Adams.

Gouldia cerina C. B. Adams.

This species was collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom. This is by far the most southern habitat for the species yet recorded.

Suborder **LUCINACEA.**

Family UNGULINIDÆ?

Genus **CRYPTODON** Turton.

Cryptodon barbarensis Dall.

Plate VIII, Fig. 9.

Shell white, superficially chalky, rather compressed, rounded below, the beaks not very prominent; the surface is sculptured only with incremental lines; there is a rather large impressed lunular area not circumscribed by a line; behind there is an upper, narrow and deep radial depression with a lower, wider and less marked second one, which make corresponding flexuosities of the posterior margin; a narrow rather deep groove runs near the margin outside the ligament marking off a narrow elongated escutcheon; interior white, unpolished; hinge edentulous. Maximum longitude of shell 17; altitude 17; diameter 10mm.

HAB.—U. S. Fish Commission Station 2840, off the Santa Barbara Islands, California, in 276 fathoms, green mud.

This fine species is nearer *C. Sarsii* than any other, but has decidedly more elevated and narrower beaks. It is probable that all these shells should be called *Axinus*, as there can be little doubt that his fossil type really belongs to this group. As long as even that little exists, however, it is a question whether Sowerby's name should be adopted.

Soft parts.—The foot is extremely slender (0.5mm), with a small spindle-shaped dilation at the distal end, circularly rugose, and about 40mm long, as contracted in alcohol. The gills are as long as the shell, or nearly; the stem has a dorsal and a ventral lamina, and the dorsal lamina is reflected outward and downward, until its lower margin is on a level with the stem. There is only one pallial and branchial opening,

with the edges posteriorly thickened or infolded but nearly smooth. The anal opening has no tube, but forms a simple long ovate slit. The gills are free, except proximally, over two-thirds of the whole length is unattached. The mouth is small, with a narrow raised edge like a Polyzoon epistome, but no palpi. The ovarian and hepatic lobules are attached on each side of the foot and ramify from a central area of attachment in a very large number of short stout spongy lobules, recalling the digitations of some keratose sponges. The ova are minute and yellowish. The hepatic granules are dark brown or grayish. The whole mass of the genito-hepatic organs nearly fills the mantle cavity, and is larger than all the rest of the soft parts put together. These lobules are not like the pyriform projections of *Myonera*, each of which projects singly from the rounded surface of the visceral mass, and probably subsides after the period of ovulation. In *Cryptodon* the whole mass on each side arises from a single small area, and digitates afterward.

Cryptodon fuegiensis sp. nov.

Plate XIV, Fig. 2.

Shell large, white, thin, suborbicular; concentric sculpture of incremental lines; radiating sculpture of one sharp groove near and parallel with the posterior hinge-margin, its termination indenting the margin, and a wider shallow sulcus below it also causing a flexuosity on the posterior margin; an obscure groove anteriorly bounds a lunular area, and there are several faint indications of other radii near those above mentioned; surface of the valves microscopically granulous, covered with a mostly dehiscent pale straw-colored epidermis; valves only moderately inflated; ligament long, black, deep-seated; hinge edentulous; interior of shell faintly radiately striate; scars distinct, with rather irregular outlines; margin sharp, simple; maximum longitude of shell 25; altitude 21.5; diameter 14.4; vertical from the umbones behind the anterior end 7^{mm}.

HAB.—Station 2779, in the Straits of Magellan, in 77½ fathoms, ooze, temperature 46°.9 F.

This splendid species is one of the largest recent forms known, and was discovered in fragments which admitted of reconstruction.

There does not appear to be any fossil species on the coast of South America which is nearly related to *C. fuegiensis*, but it may be mentioned that the *Venus bisectus* Conrad (Wilkes Exploring Expedition, Dana Geological Report, p. 724, pl. 17, fig. 10), afterward referred by Conrad to *Cyprina* (Am. Jour. Conch., 1, p. 153, 1865) is a fine species of *Cryptodon* or *Axinus*. I hope before long to publish a revised list of these Oregonian fossils referred by Conrad to the Eocene, some of which appear to be closely related to some of those forms figured from the Tertiary of Chile by the venerable Dr. Philippi in his latest works.

Cryptodon pyriformis Dall.

Plate XIV, Fig. 1.

Cryptodon pyriformis Dall, Bull. Mus. Comp. Zoöl., XII, p. 267, 1886.

HAB.—U. S. Fish Commission Stations 2646 and 2678, off the eastern coast of the United States, from Cape Fear to Florida, in 85 to 731 fathoms; also by the *Blake* in 640 fathoms in Yucatan Strait.

Cryptodon ovoideus Dall.

Plate XIV, Fig. 3.

Cryptodon ovoideus Dall, Bull. U. S. Nat. Mus., No. 37, p. 50, No. 211, 1889.

HAB.—U. S. Fish Commission Station 2626, in 353 fathoms, sand, 87 miles off Cape Fear, North Carolina, temperature 40° F.

The shell is yellowish-white and somewhat earthy, and measures 25 by 20^{mm}, with a diameter of 14^{mm}. The surface is somewhat malleated and the lunule short, wide and deep.

Family LUCINIDÆ.

Genus **LUCINA** Bruguière.

Lucina sombrerensis Dall.

Plate XIV, Fig. 13.

Lucina sombrerensis Dall, Bull. Mus. Comp. Zoöl., XII, p. 264, 1886.

HAB.—Stations 2646 and 2648, in 84 to 85 fathoms, sand and mud, off Cape Florida. Also in the Gulf of Mexico and off Sombrero Island, West Indies, by the *Blake*, in 50 to 72 fathoms.

Lucina leucocyma Dall.

Plate XIV, Figs. 6, 7.

Lucina leucocyma Dall, Bull. Mus. Comp. Zoöl., XII, p. 264, 1886.

HAB.—Off the eastern coast of the United States, the Gulf of Mexico and the West Indies, in from 5 to 683 fathoms. Collected by the *Albatross* at Stations 2117, 2595, 2596, 2600, 2602, 2646, and 2648.

Lucina sagrinata Dall.

Plate XIV, Fig. 11.

Lucina sagrinata Dall, Bull. Mus. Comp. Zoöl., XII, p. 265, 1886; XVIII, p. 439, 1889.

HAB.—U. S. Fish Commission Station 2646, off Cape Florida, in 85 fathoms; also in the Gulf of Mexico by the *Blake* in 182 to 300 fathoms.

Lucina pecten Lamarck.

Lucina squamosa Lamarck.

Lucina costata Tuomey & Holmes.

Lucina trisulcata Conrad.

The above-mentioned species of *Lucina* were obtained at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom. *L. pecten* was also collected at the Abrolhos Islands, off the coast of Brazil, near Bahia.

Family DIPLODONTIDÆ.

Diplodonta soror C. B. Adams.

Diplodonta semiaspera Philippi.

The above species were collected at Station 2766, off the Rio de la Plata, in 10½ fathoms, sand.

Diplodonta subglobosa C. B. Adams.

This species was collected at Station 2758 with the species of *Lucina* above mentioned.

Suborder CHAMACEA.

Family CHAMIDÆ.

Genus **CHAMA** Bruguière.

Chama sarda Reeve.

This well-characterized species was collected at the Abrolhos Islands, Brazil.

Suborder CARDIACEA.

Family CARDIIDÆ.

Genus **CARDIUM** Linné.

Subgenus LOPHOCARDIUM Fischer.

Lophocardium Fischer, Man. de Conchyl, p. 1038, 1887. Type *C. Cumingi* Adams & Reeve.

Lophocardium Annettæ Dall.

Plate x, Fig. 4.

Lophocardium Annettæ Dall, Nautilus, p. 13, June, 1889.

Shell thin, inflated, subovate, longer than high; color rose red with a tinge of salmon-color; covered with a thin dehiscent papyraceous epidermis produced on the edges of the elevated sculpture; umbones in-

flated subcentral with the color deeper than on the rest of the shell; sculpture of fine very numerous radiating grooves with broader flat interspaces or flattened riblets, crossed by fine concentric, slightly irregular narrow ridges made more prominent by the slightly projecting epidermis; on the posterior sixth of the shell the radiating riblets are coarser and slightly rounded, crossed by rather distant more elevated concentric laminæ fringed with epidermis; the posterior area separated from the rest of the surface by a slightly elevated somewhat curved radial lamina which is minutely frilled or puckered in such a way that its edge where unbroken is delicately notched. Posteriorly the shell gapes a little; the anterior margin is evenly rounded, below evenly arched, posteriorly subtruncate and everywhere simple and sharp; the cardinal margin is reflected and elevated before the umbo, more depressed behind it with a delicate ligamentary insertion plate; there are no lateral teeth in either valve; in the right valve the inner edge of the hinge-plate is continued as an elevated line above which the upper posterior margin is produced vertically, making this valve a trifle larger than the other, and more angular at the upper end of the truncation; in the right valve are two slender curved cardinal teeth, the longer notched near its tip, in the left valve a single tooth excavated above. Longitude of shell 29; altitude 25; maximum diameter 20^{mm}.

HAB.—Coast of Lower California at Station 2828 in north latitude 24° 11′ and west longitude 109° 55′ in 10 fathoms; fragments were collected at Stations 2823 and 2826, in 8 to 27 fathoms, shelly bottom, within a few miles of the preceding and also in material dredged near San Clemente Island in 25 fathoms.

The soft parts of this species resemble those of other Cardiums, except that the siphonal septum is produced forward to and around the foot, completely separating the anal and branchial chambers. This septum is thin, membranous, and imperforate except for the foot. The siphonal orifices are profusely papillose and most of the soft parts are of a pinkish color.

This shell differs from all other Cardiums, recent or fossil (except *C. Cumingi*), in the total absence of lateral teeth The section *Lophocardium* of Fischer was based on the prominent radial lamina of *C. Cumingi*, but an examination made at the British Museum by the courtesy of Mr. E. A. Smith, at my request, showed that that species partakes of the same hinge characters. For this reason I raised the section to the rank of a subgenus under Dr. Fischer's name.

From *C. Cumingi*, which was obtained from the same region, the present species differs in form, in details of sculpture, and in the less elevated radial lamina. It is one of the most beautiful shells of the genus, but so fragile that it is extraordinary that even a single specimen was obtained in a perfect state.

The soft parts resemble in the main those of other Cardiums except in regard to the siphonal septum. A partial siphonal septum is com-

mon among Pelecypods, especially short-siphoned forms, where the internal septum may, to a certain extent, make up for the absence of the long and complete division between the passages in those forms with long siphons. The septum is usually a mere subtriangular thin membranous shelf, the posterior extension of the tissues which separate the two siphons, while from near its lateral corners radiate the muscles which in those forms with a pallial sinus serve to retract the siphons. Below it is the more fleshy languette or curtain-valve which closes the incurrent siphonal opening when required. Among those forms in which we may find the septum especially well developed are the different groups of *Cardium*. In *C. edule* a short septum is present, and is figured by Deshayes (Moll. Algerie, Pl. XCVII., Fig. 6), in which an opening appears above and behind the valvular languette. I suspect this to be due to lesion, as I have not found such an opening in any of the species of *Cardium* I have examined. In another species, *C. hians* (*op. cit.*, Pl. XCVI., Fig. 2), the septum is considerably extended forward. The present species has the ordinary gills of *Cardium* well developed, with their posterior anchorage high up and near the siphonal septum at its origin. The septum thin, slightly fibrous, but nowhere fleshy, extends forward to the foot and on each side of it. In this case there is no orifice above the languette, or elsewhere in the partition. Doubtless an exhaustive search would find many other groups in which certain members exhibit a siphonal septum, more or less completely dividing the peripedal chamber. Until the character has become more particularly specialized and permanently established, it is evident it can have but a minor value as a guide to the systematist, or a test of his classification.

Suborder ISOCARDIACEA?

Family ISOCARDIIDÆ.

Genus CALLOCARDIA A. Adams.

Callocardia A. Adams, Ann. Mag. Nat. Hist., XIII, p. 307, 1864. Dall Bull. Mus. Comp. Zoöl., XII, p. 272, 1886. Type *C. guttata* A. Adams.

To the kindness of Mr. Edgar A. Smith, of the British Museum, I owe a careful drawing of the interior and hinge of the unique left valve of Adams' type of *Callocardia*. This is reproduced here, having never been figured. *Meiocardia* H. & A. Adams differs from *Callocardia* not only in the shape of the shell but in the form of the cardinals, the principal lamella of which is externally carinated, the carina running down and outward below and coiling into the spiral umbo. The teeth in the whole of this family are peculiar, they seem appressed against rather than to rise from the cardinal margin and are separated by deep sockets or pointed holes; the teeth themselves seem to be composed of one or two lamellæ, springing from the umbonal hollow and termi-

nating fan-like in several scallops or subsidiary flat denticles. The groups related to this genus are as follows:

PALLIAL LINE SIMPLE.

Kelliella (*miliaris*) Sars. Teeth well figured by G. O. Sars. Size small; teeth small, short, angular, ligament largely internal.

Vesicomya (*atlantica*) Dall. Size variable to large, teeth lamelliform, long, very flat, the middle one hardly curved, hardly separable from the thin long posterior lamella, deeply severed from the anterior and largest lamella; ligament wholly external.

Callocardia s. s. (*C. guttata*) Adams. Cardinal teeth arched in the left valve, short; ligament in a deep groove, chiefly external; posterior lamella separate, thin, rather long.

PALLIAL LINE DEEPLY SINUATED.

Callogonia (*Lecana*) Dall. Anterior cardinal and middle lamella continuous, angularly bent like a flattened M; posterior lamella short, high, separate; ligament inset but wholly external. Right valve with middle tooth strong deeply angulated, posterior lamella absent or represented by a spur or point just below and behind the posterior limb of the middle tooth; above this a socket for the reception of the posterior lamella of the other valve. The anterior lamella thin, concave upward, its edge somewhat irregular, sometimes faintly notched.

It is almost impossible by words to describe comprehensively these curious lamellar teeth; the reader may, however, with the aid of the figures, understand fairly well how they are arranged. The teeth of *Kelliella* are less lamellar than those of the other groups, are shorter and more triangular. The genuine fry of *Isocardia cor*, with which Jeffreys confounded *Kelliella miliaris*, has much thinner, flatter, more parallel teeth, very like those of *Vesicomya*, plus a lateral tooth.

The group named by me *Venericardiella* in 1886 (*Atopodonta* of Cossman, 1887) may belong here, and in that case would follow *Callogonia*, having a moderately sinuated pallial line.

The species known to belong to the groups above mentioned are as follows:

I. *Kelliella miliaris* Philippi (+*abyssicola* Sars).

II. *Vesicomya subquadrata* Jeffreys sp.; *V. atlantica*, *V. pacifica*, and *V. Adamsi* Smith; *V. pilula* and *V. venusta* Dall.

III. *Callocardia guttata* A. Adams, *C. albida* and *C. Smithii* Dall. The last was, before it was thoroughly studied, referred by me to *Vesicomya*.

IV. *Callogonia Lecana* Dall.

Subgenus CALLOCARDIA s. s.

Callocardia guttata A. Adams.

Plate x, Fig. 5.

Callocardia guttata A. Adams, Ann. Mag. Nat. Hist. XIII, p. 307, 1864.

The figure above referred to is reproduced for comparison from the drawing of the unique left valve in the British Museum, for which I am

indebted to Edgar A. Smith, esq., assistant, British Museum, in charge of the collection of Mollusca. It was found near one of the Japanese islands, Quelpaart, in the Kurile chain, in 48 fathoms, and externally is smooth, white, lightly maculated with yellowish spots.

Callocardia albida sp. nov.

Shell small, inflated, white, with a very thin pale dehiscent epidermis; sculpture of rather coarse, somewhat irregular concentric lines and grooves, in harmony with the incremental lines; beaks high, stout, inflated; shell almost exactly the shape of *Cytherea albida;* lunule short, wide, marginated by a distinct groove; ligament short, wholly external; escutcheon none, or undefined by any ridge; anterior end rounded, posterior end slightly more pointed; interior white smooth, the muscular scars faint, the pallial line simple, indistinct; teeth in the left valve two; one representing the fused middle and anterior tooth is formed by the ventral margin of the hinge-plate projecting laterally in a squarish elongate lamina showing two short curves concave downward and meeting each other at a slight ridge, at the termination of which is a small indentation in the profile of the lamina; the other tooth is close to the dorsal side of the hinge-plate, wholly separated from the other lamina, than which it is lower and less curved; it lies directly under the ligament; altitude of shell 8; longitude 9; diameter 7^{mm}.

Hab.—U. S. Fish Commission Station 2762, in 59 fathoms, mud, east from Rio Janeiro; bottom temperature 57° F.

A single left valve was obtained. This species is quite near *C. Adamsi* from Sierra Leone, but has fuller and stouter beaks and a more elongated and *Cytherea* like outline; the lunule is also smaller and proportionately broader; the teeth differ in small details, being stout and curved, not flat and low as in the typical *Vesicomya.*

Callocardia Smithii Dall.

Plate x, Figs. 1, 2, 3.

Callocardia (*Vesicomya*) *Smithii* Dall, Bull. Mus. Comp. Zoöl., xviii, p. 439, June, 1889.

Shell pale straw color or yellowish white, glistening, sculptured with fine somewhat irregular, rounded concentric incremental ridges, hardly elevated above the general surface; valves full, evenly rounded below and behind, with a few, inconstant, extremely faint, radiating impressions behind the beaks which do not essentially modify the margin or the sculpture; beaks rather anterior, full, not bulbous; a feeble impressed line proceeding from them marks the boundary of the lunule; above and below this are two other slight flexures not concentrated into lines, of which the lower one coincides with an extremely faint wave on the margin; interior white, polished; muscular scars narrow, the pallial line simple with an extremely faint flexure just before it joins the posterior adductor scar; scar of the pedal muscle just above the anterior

adductor, small, elongate-triangular, deep; margin smooth simple. Longitude of shell 28; altitude 22; diameter 15mm.

HAB.—U. S. Fish Commission Station 2754, east of Tobago, in 880 fathoms, globigerina ooze; bottom temperature 37°.9 F.

A number of loose valves of this interesting species were obtained as above stated, but no specimens containing the soft parts.

On a cursory examination this species was referred to the *Vesicomya* section of the genus, but from a more thorough study it became evident that it was more nearly allied to the typical *Callocardia*. The ligament is delicate and though somewhat inset is wholly external. The anterior dental lamina in the right valve has an elevated equilateral triangular point; the upper lamina is also triangular, but has a short anterior side and a long gradual posterior slope, the edge of which is slightly undulated and grooved above, so that, while really continuous with the posterior lamina which is slightly thicker, a vertical view as in Fig. 2 gives the impression of two teeth. The anterior lamina is the largest. Close to the outer margin of the ligamentary furrow is a well marked ridge which forms the boundary of the escutcheon, but is hardly visible in a profile view of the shell.

Subgenus CALLOGONIA Dall.

Pallial line with a deep narrow sinus.

Callogonia Leeana Dall.

Plate x, Figs. 6, 7, 8, 9.

Callocardia (*Callogonia*) *Leeana* Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 440, June, 1889.

Shell narrow, elongated, slightly compressed, white, with a pale yellowish epidermis and a sculpture of faintly elevated fine concentric lines coincident with the lines of growth; umbones not prominent; anterior end rounded; posterior end moderately, obliquely subtruncate rounded off above, slightly pointed below; there is no line circumscribing a lunular space, and the ridge, if any, bordering the ligament is so fused with the margin of the ligamentary groove that the shell may be said to have no escutcheon; there are a few irregular extremely faint radiating lines, and a rounded ridge hardly defined extends from the beaks to the lower posterior angle. Internally the shell is smooth, white; the adductor scars larger proportionally and rounder than in *C. Smithii*, the pedal scar deep but relatively smaller; the pallial line is broad, with a deep angular sinus; the margin simple, smooth; in the right valve the anterior lamina is longest and is concave upward with a rounded profile; the middle lamina is strongly bent with the angle upward and is higher than the others; to it is attached the short thin posterior lamina which is the lowest of the three with a sort of socket above for the corresponding lamina of the other valve; the posterior

lamina is strengthened by a buttress from the ventral edge of the hinge; below the middle lamina is a deep pit; another pit is found above the anterior lamina; the ligamental groove is well marked. In the left valve the middle tooth is thick and bent but with no pit below it; a deep notch separates it from the anterior lamina; behind or above these two is a deep irregular groove; the posterior lamina is independent, straight, short, with a deep groove between it and the surface to which the ligament is attached. The altitude of a young but perfect specimen is 20; the length 28; and the diameter 12mm. Fragments show that the species attains nearly twice this size.

Hab.—U. S. Fish Commission Station 2754, east of Tobago, in 880 fathoms, globigerina ooze; bottom temperature 37°.9 F.

Figures 8 and 9 show the hinge of a well grown specimen. A view from below of the hinge of the right valve, from a fragment of a still larger specimen, shown by Fig. 7, will assist in making clear the complicated mechanism of the hinge.

This species, compared with the typical *Callocardia*, shows how short is the interval which in some cases separates species with a deep pallial sinus from species with none; another instance is the relation of *Veneriglossa* Dall (*Atopodonta* Cossman) with *Cytherea*. It is probable that neither of the *Callocardiæ* have long siphons, though one has retractor muscles and the other none, or none to speak of. These characters are like the branchiæ, essentially adaptive and relatively superficial, and can no longer be regarded as of high systematic importance, except when correlated with other more fundamental features.

It is rather curious that a close inspection shows that the cardinal teeth of a young *Isocardia cor*. L. are more like those of *Vesicomya* than like those of *Kelliella miliaris*, with which Jeffreys confounded the young of the first mentioned species, to say nothing of *Kelliella* having not the slightest trace of a lateral tooth.

This species is named in honor of Prof. L. A. Lee, in charge of the scientific work on the *Albatross*.

VENERIGLOSSA Dall.

Veneriglossa (subgenus of *Cytherea*) Dall, Bull. Mus. Comp. Zoöl., XII, p. 275, 1886.
Atopodonta Cossman, Mem. Soc. Roy. Mal. Belg., XXI, p. 110, 1887.

Veneriglossa vesica Dall.

Plate XIV, Figs. 8, 12.

Cytherea (*Veneriglossa*) *vesica* Dall, *op. cit.*, p. 275, XVIII, p. 440, 1889.

Hab.—Gulf of Mexico and West Indies, in 84 to 100 fathoms. This problematical shell is figured here for comparison with the preceding species of *Isocardiacea*.

Suborder VENERACEA.

Family VENERIDÆ.

Genus **VENUS** Linné.

Subgenus CHIONE Muhlfeldt.

Chione cancellata Linné.

This well known species, which ranges north to Cape Hatteras, was collected at Port Castries, Santa Lucia Island, West Indies; at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom; and at the Abrolhos Islands, off the coast of Brazil, near Bahia.

Chione rugosa Gmelin.

This species, which is known from Hatteras south to Rio Janeiro and on both coasts of Central America, was obtained at Station 2758.

Subgenus ANAITIS Römer.

Anaitis varicosa Sowerby (1853).

This species, which is abundant off Hatteras and fossil in several of our tertiary strata (under various names), was collected at Station 2758. It is very close to if not identical with *Venus alveata* Conrad, 1831.

Genus **CYTHEREA** Lamarck.

Cytherea hebræa Lamarck.

Young specimens of this species were obtained at Station 2758.

Cytherea eucymata, sp. nov.

Plate XIII, Fig. 11.

Cytherea sp. (No. 290) Dall, Bull. U. S. Nat. Mus., No. 37, pp. 56, 57, August, 1889.

Shell thin, inflated, concentrically ribbed, waxen white or pale brown, with clouds and zigzag fluctuations of madder brown, polished; adult with about fifty rounded slightly flattened concentric waves with a short dorsal and long ventral slope, separated by narrow sharp grooves; these waves become fused in pairs or alternately obsolete and raised into more thin and elevated lamellæ near the posterior dorsal margin; radiating sculpture none, except a narrow ridge bordering the ligamental furrow and the groove which circumscribes the lanceolate lunule; there is no escutcheon; margin elegantly rounded, a little straighter along the ligamental border, outline ovate; beaks full, not prominent; hinge of the genus; the lateral tooth conic in the young, compressed in the adult; margin rounded, smooth; pallial sinus not quite reaching the vertical from the beaks, rounded or subtruncate at

its inner part. Adult, maximum longitude 40, altitude 32, diameter 26, vertical from the beaks behind the anterior end 10; young, maximum longitude 14.5, altitude 11.5, diameter 7.5, vertical 4.5mm.

Hab.—Station 2402, between the Mississippi delta and Cedar Keys, in 111 fathoms, muddy bottom; stations 2604 and 2606, off Cape Hatteras, North Carolina, in 25 to 34 fathoms, sand; west of Florida, in 50 fathoms (U. S. S. *Bache*); station 2640 and 2646, off the southern part of Florida, in 56 to 85 fathoms, sand; and station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom; temperatures 77° to 79°.1 F.

This remarkably elegant species has about the form of *Dione Kingi* Gray as figured by Reeve (Conch. Icon. *Dione*, Pl. IX, Fig. 36*a*) with somewhat the sculpture of *D. grata* and *D. erycina*. It recalls in its coloration *Tapes turgida* Lamarck and *T. lirata* Philippi, minus their dark radiating bands. It is like none other on the east coast of America and has been for several years recognized by me as undescribed, from the specimens in the National Collection.

Subgenus CALLISTA (Poli) Mörch.

Callista maculata Linné.

This species was collected at Station 2758.

Suborder TELLINACEA.

Family TELLINIDÆ.

Genus **MACOMA** Leach.

Subgenus CYMATOICA Dall.

Shell telliniform, without lateral teeth, with two small grooved cardinal teeth in the right valve, one in the left valve, and no laterals; with the external surface covered with wavy sculpture not in harmony with the direction of the incremental lines; with the anterior portion of the shell longest, the posterior strongly flexed, and with the pallial sinus deep but free from the anterior adductor scar in both valves.

Cymatoica occidentalis sp. nov.

Plate X, Fig. 11.

Shell small, thin, white, moderately full in front, compressed and strongly twisted to the right, behind; anterior part of the shell the longer, sloping from the beaks, gently rounded toward the base; beaks small, pointed, not inflated; posterior portion of the valves rapidly attenuated, compressed, rostrated and somewhat obliquely truncated; sculpture of small, narrow, rounded, nearly equidistant waves, not in harmony with the incremental lines and showing in different specimens slight differences of prominence and direction; in general they have a longitudinal direction, rising as they pass backward; those near the

margin are sometimes broken up into short segments, and on the opposite valves of the same specimen there are usually perceptible but not constant differences in the sculpture, which is fully reflected on the polished interior of the delicate valves; ligament thin, short; lunular area long, very narrow, smoother than the rest; rostrum transversely striated with two or three obscure radial ridges, the most anterior of which forms the boundary behind which the waved sculpture does not pass; interior polished, scars of adductors obscure; pallial sinus deep, rounded, reaching to or into the anterior third of the shell; teeth small, short, simple in the young, grooved on their outer surface in the adult, the single tooth in the left valve showing the grooving most strongly. Maximum longitude of shell, 12.5; altitude, 6; diameter, 3mm.

HAB.—U. S. Fish Commission Station 2823, in latitude 24° 18′ N., longitude 110° 22′ W., off the coast of Lower California, in 26½ fathoms, fine sandy mud.

This interesting little shell gapes, if at all, but slightly and only at the tip of the rostrum.

Cymatoica orientalis sp. nov.

Plate x, Fig. 12.

Shell white, thin, resembling the last species, but with the beaks more central and less pointed, the posterior end broader at the more vertical truncation and less rostrate, the valves slightly flatter and the wavy sculpture distinctly angulated at an oblique line radiating from the beaks somewhat forward; there are no visible radii on the rostrum, but the wavy sculpture does not pass forward of a diagonal from the beak to the lower posterior angle of the shell; the lunular area is wider and more deeply impressed than in *C. occidentalis*, and the posterior end of the shell is less strongly flexed. Maximum longitude, 9.5; altitude, 5.5; diameter, 3mm.

HAB.—Samana Bay, Santo Domingo, in 16 fathoms, mud, Couthouy; also in the same depth at Cardenas, Cuba, from T. H. Aldrich, esq.

This little shell has been many years in my hands awaiting a name. When an analogous species appeared in the Fish Commission collections from the Pacific it seemed a suitable occasion to put them on record together. The wavy sculpture in this species is sometimes a good deal broken up anteriorly.

Subgenus MACOMA s. s.

Macoma brevifrons Say.

Tellina brevifrons Say, Am. Conch., VII, Pl. 64, Fig. 1, 1834.

The shell, which I have identified as the true *brevifrons* of Say, though with some hesitation, agrees well, when young, with Mr. Say's description and passably well with his figure. The latter is usually on the plate colored so that it does not agree with the text, which was published after Mr. Say's death. The adult shell is proportionally longer

than the above-mentioned figure, and is characterized by a suffusion of dull rufous or orange color in the interior and toward the beaks, the tips of which, however, are usually paler. Stimpson, from a comparison with Say's specimens, named the specimens found by him in Charleston Harbor *T. brevifrons*, and I have followed him.

The shell is rare in South Carolina, extends to Florida and Texas, is reported from the West Indies in several localities, and has been erroneously identified with *T. candeana* Orbigny.

Its southward range is now extended by the U. S. Fish Commission to Station 2764, in 11½ fathoms, off the Rio de la Plata, in south latitude 36° 42′ and west longitude 56° 23′, on a sandy bottom.

Family SEMELIDÆ.

Genus **ABRA** Leach.

Abra longicallus Scacchi.

This well-known abyssal shell was collected at Station 2751, south of St. Kitts, in 687 fathoms, ooze; Station 2754, east from Tobago, in 880 fathoms, ooze; and Station 2760, 90 miles north from Ceara, Brazil, in 1,019 fathoms; temperatures 37°.9 to 39°.9 F.

Genus **ERVILIA** Turton.

Ervilia concentrica Gould.

This species was collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom.

Genus **SEMELE** Schumacher.

Semele reticulata Gmelin.

This species was collected at Station 2758; at Stations 2765 and 2766, off the Rio de la Plata, in 10½ fathoms, sand; and at the Abrolhos Islands, off the Brazilian coast, near Porto Allegre. It ranges northward to Virginia and the Bermudas.

Semele cancellata Orbigny.

This very characteristic species was collected at Station 2758, which greatly enlarges its known southward range. Its northern limit as far as known is the vicinity of Cape Hatteras, North Carolina.

Semele nuculoides Conrad.

Plate XIV, Fig. 5.

Semele nuculoides Dall, Bull. U. S. Nat. Mus., No. 37, p. 62; No. 371, August, 1889.
? *Amphidesma nuculoides* Conrad, Am. Journ. Sci., XLI, p. 347; Miocene Foss., p. 73, Pl. 41, Fig. 6.

HAB.—Stations 2597, 2602, 2607, 2608, 2610, 2611, 2612, 2615, 2617, 2619, 2622, and south to the West Indies, in 2 to 124 fathoms, extending north to Cape Hatteras.

This curious little shell is probably the same as Conrad's Miocene fossil; at all events it is fossil in the Miocene. I have received it under the name of *Montacuta lirulata* Carpenter, from the West Indies. It is yellowish, sometimes radiated with red, closely concentrically waved and quite compressed. It differs from most species of *Semele* in its small size and erect beaks, but in nothing else so far as the shell is concerned. *Semele cancellata*, both in size and attitude of the umbones, forms a transition from this little member of the group to the ordinary type.

Order ANOMALODESMACEA.

Suborder ANATINACEA.

Family ANATINIDÆ.

Genus ASTHENOTHÆRUS Carpenter.

Subgenus BUSHIA Dall.

Bushia (elegans var?) Panamensis Dall.

Shell resembling *B. elegans* in all respects except that the single valve collected is proportionately higher, the umbo more central, the anterior end more evenly rounded and the posterior end shorter and more vertically truncate. Maximum longitude of (right) valve 14; altitude 11.3; (semi) diameter 4; vertical of beaks behind anterior end, 8mm.

HAB.—Station 2805, in 51 fathoms, mud, in Panama Bay.

It is very interesting to find *Bushia* on the west coast as *Asthenothærus* was found in Florida, each having first been described from the opposite shore of the continent.

Genus THRACIA Blainville.

Thracia distorta Montagu.

Thracia distorta Montagu, Dall, Bull. Mus. Comp. Zoöl., XII, p. 307, 1886; List of Marine Mollusks, U. S. Nat. Mus. Bull., 37, p. 64. No. 383, 1889.

This species has already been reported from Honduras as well as European seas, and was collected by the *Albatross* at Station 2764, in 11½ fathoms, sand, off the Rio de la Plata.

Thracia Stimpsoni Dall.

Plate XIII, Fig. 2.

Thracia Stimpsoni Dall, Bull. Mus. Comp. Zoöl., XII, p. 307, 1886.

This fine species was collected by the *Albatross* in 28 fathoms in the Gulf of Mexico, on the line between Tampa and the Dry Tortugas, at U. S. Fish Commission Station No. 2410. Its nearest relative is *T. convexa* Wood, from which it differs in proportions and sculpture. With the exception of the northern *T. Conradi*, it is the largest American species.

Family LYONSIIDÆ.?

Genus LYONSIELLA Sars.

Lyonsiella radiata Dall.

Plate VIII, Fig. 7.

Lyonsiella radiata Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 442, June, 1889.

Shell large, thin, pearly, recalling *L. gemma* Verrill (=*insculpta* Jeffr.+ *ecostata* Seguenza), but very much larger, higher, less rounded anteriorly, less pointed behind, and more produced and rounded ventrally; hinge simple, undulated, with a rather large, arched ossicle; exterior whitish, with a thin olivaceous epidermis raised over five ribs into rather high distant radiating ridges, to which mud adheres tenaciously; incremental lines distinct, silky, sometimes prominent; lunule in the right valve impressed, produced laterally, not marginated; interior pearly, with faint radiating sulci, corresponding to the external ridges; maximum altitude of shell, 13; longitude, 11; diameter, 8.5mm.

HAB.—In Magellan Straits, at U. S. Fish Commission Station 2780, in 369 fathoms, mud; and at Station 2785, off the west coast of Patagonia, south latitude 48° 9′, in 449 fathoms, mud; temperatures 46°.9 F. in both cases.

There are a large number of acephalous mollusks, not necessarily nearly related, in which a true branchial septum exists. In a young *Perna*, supposed to be *P. ephippium* L., the inner edges of the etenidia are united to each other their whole length behind the foot. The outer edges are attached to the mantle, or visceral epiderm, so as to form a complete chamber, like that of *Cuspidaria*, but of which the derivation is radically different. In *Modiolarca trapesina* Lam., from Cape Horn, the etenidia, from below the anal siphonal orifice to and around the foot, are united as in *Perna*. The chamber thus constituted is crammed with the young fry at the proper season. In *Lyonsia beana* Orb. the united etenidia are attached above the rudimentary siphonal septum, extend forward to and around the foot. They are attached to each other and to the mantle, or to the ventral surface of the visceral mass, by their edges and form a most complete chamber, a true etenidial septum. There are, however, no orifices in this or in any of the species with a strictly etenidial septum corresponding to the septal perforations in *Poromya* or *Cuspidaria*.

In *Lyonsia radiata* we have a similar state of affairs, except that the anterior inner edges of the gill are not so closely united around the foot. The part played by the siphonal septum in this species is insignificant; it is in fact hardly perceptible. The infolding of the mantle edge around the siphon is very wide; its outer edge is nearly plain. Within this edge a short distance is an elevated ridge, with a single row of small, rounded, ocellus-like tubercles on each side of it. A wide space sep-

arates this range of processes from the margin of the branchial orifice, which is profusely papillose with arborescent papillæ. A lunate depression lies between this and the much smaller, plain-edged, nearly linear anal orifice, while in front of it the pedal opening forms a minute narrow slit, with granulated margin. In this form the palps are represented by a slightly raised edge around the mouth, not produced or elongated at the sides. A languette or curtain valve hangs behind the branchial orifice below the narrow septum.

The balance of characters will perhaps carry *Mytilimeria* and *Lyonsiella* to the *Anatinidæ*, or a family by themselves, rather than to the *Verticordiidæ*, where I first placed them. But they are transitional in their relations, and in spite of the relations between the form of the gills in *Lyonsiella* and *Lyonsia*, I am still inclined to think the former almost equally close to *Verticordia*. A supposed discrepancy, noted by Pelseneer, arises from the fact that, instead of comparing *Lyonsiella* with a genuine *Verticordia*, like *acuticostata*, as I did, he compares it with a species of *Poromya*, which is, of course, a very different thing.

Family VERTICORDIIDÆ.

Genus **VERTICORDIA** Wood.

Verticordia (Wood) Dall, Mus. Comp. Zoöl. Bull., vol. XII, p. 285, 1886.

Verticordia acuticostata Philippi.

V. acuticostata Dall, *op. cit.*, pp. 285, 288.

HAB.—Cuba, Barbados, and Gulf of Mexico, *Blake* expedition; Mediterranean, Philippi; North Atlantic, Jeffreys; Japan, A. Adams. U. S. Fish Commission Stations 2659, off Cape Canaveral, in 509 fathoms, bottom temperature 45°.2; and 2750, off St. Bartholomew, West Indies, in 496 fathoms, sand, temperature 44°.4.

This species grows to a considerable size, the two Fish Commission stations affording valves 19 and 20.5^{mm} in height respectively.

Soft parts.—Another specimen, and a re-examination of the one reported on in 1886, confirm the description then given. There are no palpi, the anterior pair are wholly unrepresented, the posterior or lower pair may be represented by two small rounded hardly elevated tubercles between the mouth and the anterior ends of the gills. The foot is relatively extremely large, round, and stopper-like. The gills in the second specimen are clearly adnate, as in Pelseneer's figure of *Lyonsiella papyracea* Smith (Chall. Rep. Anat. Moll., Pl. III. Fig. 1), except that they are underlaid by the solid fleshy siphonal septum, and do not serve to supplement that septum as they are alleged to do in *Lyonsiella abyssicola*. They are proportionately very much smaller, hardly reaching behind the middle of the foot. I suspect that the free end of the gill in my first specimen was separated by a lesion, and is not normal, but that the gill is always adnate in the adult condition.

The septum is thick and fleshy, quite destitute of perforations or orifices except that in which the foot stands.

Verticordia (Trigonulina) ornata Orbigny.

This species, already known from widely separated regions, was collected 90 miles southeast of Cape San Roque, in 20 fathoms, at U. S. Fish Commission Station 2758.

Verticordia perplicata sp. nov.

Plate VIII, Fig. 1.

Shell large, strongly plicated radially, with the hinge of *Verticordia* (restricted) and a coarsely granulous finely wrinkled external surface of a dark brown color; anterior surface with two or three strong and several smaller obscure radiating ribs which undulate the margin; behind these is the strongest broad rib with a rounded top followed by a wide sulcus, then by two somewhat smaller and one still narrower rib with increasingly narrower interspaces; then a wider, stronger, and shorter rib, a deeper sulcus, and lastly by the rounded posterior area; with these principal radii are traces of much finer ones, differing in different individuals, while the eight primary radii seem pretty constant in position and relative size; lunule very small and deeply impressed; behind it in the right valve is a single strong conical or slightly excavated tooth, convex below and short; immediately in front of the beaks the hinge line is narrow with a narrow groove for the cartilage and a short, wide, subtriangular ligamentary basis; beaks small, incurved; underneath and a little in front of the cardinal tooth is a small, deep, muscular scar; anterior adductor scar large, not deep; posterior ditto even less impressed; margins of the valves thin, undulated by the sculpture, not crenulated; interior pearly white, grooved in harmony with the external sculpture; maximum longitude of shell, 33; maximum altitude, 35; diameter, (about) 28mm.

Hab.—U. S. Fish Commission Station 2807, in 812 fathoms, mud, near the Galapagos Islands; bottom temperature 38°.4 F.

Two nearly complete right valves, fragments of several others, and fragments of two left valves were collected as above stated. When perfect this must be one of the finest species of the genus. The surface is very finely, irregularly wrinkled, with an abundant supply of rather minute pustules, rounded in the specimens but perhaps more pointed in the perfect shell. A more minute description of the hinge must await material in better condition; the data now given are quite sufficient to identify the species.

Family CUSPIDARIIDÆ.

Genus CUSPIDARIA Nardo.

Cuspidaria Nardo, Revue zoöl., p. 30, Jan., 1840.
Neæra Gray (1834), not of Robineau Desvoidy (1830).
Cuspidaria Dall, Bull. Mus. Comp. Zoöl., XII, p. 292, Sept., 1886.

Cuspidaria patagonica Smith.

Neæra patagonica Smith, Challenger Lamellibranchs p. 39, Pl. VII, Figs. 5, 5*a*–*b*, 1885.

HAB.—U. S. Fish Commission Station 2751, in 687 fathoms, ooze, off St. Kitts, West Indies, temperature 40° F. Station 2792, off Manta, Ecuador, in 401 fathoms, mud, temperature 43°, etc.

A fine specimen of this species, measuring 44mm in length and 14mm in transverse diameter, was dredged off Manta; other specimens were found in dredgings from the whole eastern coast of South America, the western coast of that continent, and northward as far as Lower California. The larger specimen afforded the following notes.

The siphonal septum, by which name I shall refer to the dividing septum of the peripedal chamber, extends forward from the proximal end of the siphons to the anterior adductor. It is divisible into three areas, a longitudinal central muscular area occupying about two-thirds of the whole septum, and on each side a less muscular, thin, and tense membranous strip, which is connected with the inside of the valves and leaves the imprint on the shell which would ordinarily be taken for the outline of the "pallial sinus." The central muscular area is attached by a bundle of muscular fibers above each adductor on each side of the median line. All four points of attachment leave well-marked scars on the shell. I have shown elsewhere that these muscles, if not homologous with, at least perform the functions of the siphonal retractors of ordinary Pelecypods, and in forms like *Poromya mactroides*, where the usual retractors are present, the siphonal septum is destitute of muscularity, or possesses it only to an inferior degree. The posterior septal muscles are smaller and rounder in section, more vertical in direction, and more widely separated from each other than the anterior pair. The latter are narrow and elongated on their surface of insertion, and but for the separation of the valves would nearly touch in the median line. The principal body of fibers on the plane of the septum is longitudinally arranged; another series crosses the septum in an arched manner toward its extremities, especially behind, while there are indications of still smaller series of more or less radiating fibers knitting the whole fabric together and to the shell.

The siphonal septum in this species divides the cavity of the shell unequally, the upper portion being smaller than the lower. In the upper, sustained especially by a median fibrous mesenteric band, is suspended the visceral sac. Viewed from above, it is subcordate in profile; from the side it seems acutely ovoid. It occupies, as contracted by alcohol, about half the cavity above the septum. The valve of the

anal siphon is represented above the septum by a thin vertical wall of membrane pierced by a relatively small simple central orifice. The valve of the branchial siphon below the septum is composed of three rather thickish processes, one hanging vertically is short, wide, and represents the languette in *Cardium*; the lateral processes are somewhat longer and obliquely set, the whole forming a large subtriangular opening with three partially overlapping curtains. Passing backward on the ventral surface of the septum, aside from the streakiness due to the fibrous coarse muscular tissue, there is a distinct narrow median depression behind the foot, except just behind the edge of the foot, where the surface in all the forms with a muscular septum is elevated like a wave rising about a solitary rock. The foot is slender, elongated, slightly geniculate, with a small byssal groove behind. Immediately in front of it the surface is depressed about the small and inconspicuous mouth. Here the anterior palps are almost wanting, but the posterior, though abnormally small, are elevated above the surface and strongly transversely striate. In front of the palps is a strong ridge of tissue, behind the anterior commissure of the lobes of the mantle. Here a narrow horny or chitinous gusset strengthens the commissure, above which is a sort of pocket or shallow indentation, above which the external margin of the mantle finally joins. The gusset is narrow, concave in the middle, with its ends spatuliform and shows brown through the white tissues, like the jaw of a Gastropod.

If the surface of the septum near the foot be closely scrutinized there will be seen on each side four slight prominences. The anterior pair are on each side of the mouth, the second and third pairs by the sides of the foot, the fourth behind the foot, all situated in the thickest part of the muscular portion of the septum. The posterior pair have two lips, the others three to each prominence, and on gentle pressure with a fine probe it will be found that a small circular orifice passes somewhat obliquely through the septum and communicates with the upper chamber.

These passages are not always complete, however; for by means of careful sectionizing I found the third pair imperforate in a fairly grown specimen of *C. rostrata*, while in several young specimens the two posterior pairs seemed imperforate. In a specimen of *C. arctica* var. *glacialis* I found five orifices on each side, showing that the number is not invariable.

The lips to these orifices are not prominent, much less so, indeed, than in *Cetoconcha* or *Poromya*. The office of a gill must, therefore, as suggested in 1886, by me in the first part of my *Blake* report (p. 303), be performed by the surface of the septum or by the lobes of the mantle. This is a very different view from Dr. Pelseneer's idea that the septum is itself homologous with the ordinary gills of Pelecypods.

By cutting the lobes of the mantle away, and carefully turning back the septum as a whole, extracting the foot from its socket, we see the

simple oblique upper ends of the septal orifices. What can their office be? I suppose that they serve to admit fresh water to the upper chamber, which I believe to be utilized in some, if not all, instances as a marsupium. It is probable that by suitable muscular contractions, the septum will operate somewhat like the washer of a pump valve, and that the upper chamber can be filled or emptied of its contained water at will.

I believe the septum in *Cuspidaria* to be homologous with the ordinary siphonal septum, only more prolonged; and that its muscular tissue is the equivalent of the siphonal retractors of ordinary Pelecypods. I do not regard it as in any manner homologous with the normal ctenidia.

Cuspidaria (?) monosteira sp. nov.

Plate VIII, Fig. 5.

Shell small, inflated, stout and strong, with a single strong vertical keel and much fainter concentric sculpture; color white, with a very thin, pale epidermis; umbones nearly central, anterior end evenly rounded from the beak to the basal end of the keel; posterior end rostrate, the rostrum short, wide, abruptly truncate; concentric sculpture of rather strong incremental lines, which at first are varied by regularly spaced, rather sharp, distant, elevated lines; later these become obscured in the stronger, more crowded, and rather irregular incremental lines; a faint ridge extends from the beak to the lower angle of the rostrum, the only other radial sculpture is the exaggerated, high, flat-topped, vertical keel; this projects from the rounded base and interrupts its curve; interior smooth, scars hardly perceptible; in the left valve the hinge-line is arched or rather angulated in the middle; there is a strong posterior lateral tooth, no anterior lateral or any cardinal teeth; the fossette is small, posteriorly inclined, and continuous with the margin of the hinge; maximum longitude of shell 5; altitude 4.25; diameter 5mm.

HAB.—U. S. Fish Commission Station 2760, 90 miles north from Ceara, Brazil, in south latitude 12° 7′, west longitude 37° 17′, in 1019 fathoms, bottom temperature 39°.4′ F.

Only a left valve of this remarkable and very characterististic little shell was obtained. As the left valve is the uncharacteristic one as regards the hinge, it is not practicable to say to which section of the genus this species should be assigned, but its characters agree with those of the left valve of *Neæra pulchella* H. Adams.

Cuspidaria (Cardiomya) striata Jeffreys.

This species which ranges northward to the Arctic Seas and whose southernmost known range was Florida Strait, was collected east from Rio Janeiro, at Station 2762, in 59 fathoms, muddy bottom. This gives an immense extension of its southward range.

Subgenus LUZONIA Dall & Smith.

Both valves without lateral teeth, right valve with an anterior cardinal tooth, left valve edentulous; exterior concentrically striate; fossette narrow, parallel with the cardinal margin under the apex. Type *Neæra philippinensis* Hinds, from Luzon and Mindanao, Philippine Islands.

This is Section II of Smith's arrangement of 1885, in the Report on the *Challenger* Lamellibranchs, p. 37.

Cuspidaria (Luzonia) chilensis sp. nov.

Plate XIII, Fig. 13.

Shell white, thin, polished, under a rusty brown, dull, caducous epidermis; beaks not prominent, nearly central; anterior hinge-margin thin, sloping evenly and then evenly rounded to the arcuate base; posterior hinge-margin declining somewhat less, nearly straight, at the end of the rostrum evenly rounded over, the end of the rostrum being rounded, not truncate. On the rostrum is an obscure ridge extending to the umbo; in front of this ridge is a wide shallow sulcus by which the basal margin at the beginning of the rostrum is rendered a little concave; there is a faint ridge or thread close to the posterior hinge margin in the left valve, but none in the right; sculpture of fine silky concentric lines, but no radii; interior polished, with a few fine radiating striæ; pallial line simple, not sinuated, vertically truncate at the beginning of the rostrum; hinge margin thin, edentulous except for a small triangular lamina in the right valve in front of the fossette; fossette narrow, directed backward, parallel with the hinge margin; ligament thin, stout, brown, re-enforced below with a narrow elongate-triangular ossiculum; maximum longitude, 11; altitude, 8; diameter, 6.6; vertical of beaks behind the anterior end, 6mm.

HAB.—Station 2791, off the southwest coast of Chili, in 677 fathoms, mud; temperature 37°.9 F.

This species has the mantle margin simple, the siphons extremely short, retracted by the septal muscles; the ova project into the anal chamber from the surface of the visceral mass in rounded lobules, much as in *Myonera*; a number of the dehiscent ova were retained in the anal chamber. There were four septal orifices on each side; their apertures simple, oval and oblique; the septum was rather muscular, but not solidly so as in *Cuspidaria*; its surface was heaped up in sundry wave-like prominences behind and on each side of the foot. The palpi were extremely small, the lower ones nearly absent; the foot was short, stout, and subconical; the anal chamber quite small.

Genus **MYONERA** Dall.

Myonera paucistriata Dall.

Plate XIII, Fig 12.

Myonera paucistriata Dall, Bull. Mus. Comp. Zoöl., XII, p. 302, 1886.
Neæra paucistriata Dall, Bush, Trans. Conn. Acad., VII, p. 473, 1885.

HAB.—Florida Keys and Windward Islands, in 339 to 464 fathoms, bottom temperature 41°.5 to 45° F. U. S. Fish Commission Stations 2644, 2678, 2751, and 2754, ranging from Cape Fear, North Carolina, to Tobago, in 193 to 880 fathoms, temperatures 27°.9 to 43°.4 F.

To the description already published of the soft parts of this extremely fragile and delicate form several points can be added from the examination of the fresh specimen. The only correction to the original description relates to the opening of the anal siphon, which is a minute circular orifice in a delicate membranous area which in life probably projects in a dome-like manner, but in alcohol appears tense and flat. The opening is into the upper portion of the peripedal chamber, of course, as in the other species. That which I took for the anal opening in the first specimen examined was an accidental lesion, while the true anal opening from its minuteness was overlooked.

The mouth, as stated in 1886, is a simple opening without palpi. The latter are represented, if at all, by a delicate slightly elevated ring of tissue which surrounds the circular mouth. The absence of gill laminæ is fully confirmed. The septal orifices on the ventral surface are hardly observable without the closest scrutiny, though easily visible on the dorsal surface of the septum. There are eight, as in the *Cuspidaria patagonica*, and their lips slightly elevated, usually appear triple, so as to give a triangular aspect to their junction. When sounded by a delicate probe they appear subtubular.

The muscular tissue of the septum is concentrated in two bunches of coarse fiber-bundles, which radiate from the posterior outer corners of the septum, suggesting that the fibers, usually devoted to retracting in a nearly vertical plane the siphons toward their angular insertion (pallial sinus) on the shell, are here spread in a horizontal plane. Beside the fasciole of fibers at the corners, there is a loosely arranged central bundle behind the foot, while the rest of the septum is more thin and fibrous, and the vertical roots of the septal muscles far less strong and prominent in proportion than in *Cuspidaria*. The arrangement of the fibers of the muscular tissue is singularly loose, and in the central area irregular; quite different from the solid tissue of the septum in *Verticordia*, or the compact bands observable in *Cuspidaria*.

The most noticeable feature in this specimen was the condition of the ovaries. These ramified over the posterior part of the visceral mass, terminating in bifurcated or trifurcated sacs, largest at their distal extremity, and somewhat fig shaped. These were crammed with ova and projected from the surface of the visceral mass into the upper chamber

above the septum. All were turgid; some had already burst and partly discharged their contents into the chamber; others seemed on the point of doing so; the alcohol had coagulated the escaping ova *in situ*, in the most perfect manner, the whole process thus being displayed. It is probable, as suggested by me in 1886, that the chamber serves to some extent as a marsupium or shelter for the ova and young, and that they are not discharged into the surrounding element at once. This is undoubtedly the case in *Modiolarca*.

Family POROMYIDÆ Dall.

Poromyidæ Dall, Bull. Mus. Comp. Zoöl., XII, p. 280, 1886; XVIII, p. 452, June, 1889.

The characters of this family are peculiar and exhibit an extreme specialization in the matter of the siphonal septum and the development of new breathing organs upon it, while the normal ctenidia have become obsolete. As the matter has been discussed with, as I believe, erroneous conclusions and assumptions by Dr. Paul Pelseneer in his account of the Anatomy of Mollusks in the series of reports on the scientific results of the *Challenger* expedition, it seems well to include here the data and conclusions to which a study of the Fish Commission and other material has conducted the writer. This has already been stated elsewhere, in the appendix to my Report on the *Blake* Mollusca, Part II, but as that publication is likely to be somewhat restricted in its audience, compared with the U. S. Fish Commissioner's reports, it is hardly necessary to apologize for introducing the same matter here; especially as it is based directly on the *Albatross* collection. Part of the data will be found under the heads of the several species, the rest is here assembled for reference.

In 1886 I separated from *Poromya* the forms which, when adult, have the hinge teeth obsolete, under the name of *Cetoconcha*. This group included not merely those with a double posterior row of modified septal orifices on each side, such as *C. bulla*, the type, and *C. margarita*, but also certain species of *Poromya*, in which the hinge teeth are feeble or obsolete in the adult, while in the typical *Poromya* they continue strong. I called attention to the fact that the soft parts of these species did not differ essentially from *Poromya*, but hardly felt justified in separating them from the typical *Cetoconchæ*. It is probable that it would be better for them to form a section of *Poromya* which may be called *Cetomya;* while the typical *Cetoconcha* may perhaps be generically separated from *Poromya*. The group in question was named *Silenia* by Mr. E. A. Smith, in his report on the *Challenger* Lamellibranchs, but that name had already been used in zoölogical nomenclature, and so was preoccupied. The observations of Pelseneer on the anatomy of *Silenia* leave no room for doubt that it is identical with *Cetoconcha*, as represented by its type and by *C. margarita*. Now that wider research has shown more clearly the characters of *Poromya* and *Cetoconcha*, the attempt of 1886 to diagnose both forms in a single definition seems confused, but

with this explanation it should be clear enough that the facts were observed and recorded in members of each group, and that the apparent confusion in the diagnosis resulted from a feeling of conservatism in the matter of subdividing genera; a proceeding which has, of late years, on some occasions been so shamefully abused.

The researches of the U. S. Fish Commission have added some most interesting and peculiar species of this family, which are more fully described in another part of this report. The forms not so described have been grouped together here.

Cetoconcha bulla was described rather fully by me in 1886, and that description merely requires the addition of the statement that the lamellæ described are subtubular and form the lips to the septal orifices. In using the term "ventral surface" at that time for the under side of the septum and "body cavity," the reader will not be misled into the supposition that the *visceral mass* was the "body" intended; for, though the words may have been ill chosen, the relations of the visceral mass were clearly stated, although the very important relation of the upper chamber to the anal siphon was not understood at the time.

There is in this species a distinct bunching of the muscular fibers at the posterior outer corners of the septum, from which points they extend in a somewhat radiating manner. The soft parts, though more rotund and with a different number of septal orifices, resemble sufficiently those of *Cetoconcha Sarsii* Smith, as digrammatized by Pelseneer. For each orifice two lamellæ are usually counted in the report of 1886, as the lips of the septal orifices generally appear paired and arched, forming a segment of a circle. In *C. bulla*, in the anterior series, there are five orifices on each side; the inner posterior series have three to five and the outer posterior series two, or possibly three, orifices each. The number of posterior orifices is not the same in the two specimens of *C. bulla* examined.

In none of the specimens of *Cetoconcha* examined by me were the inner ends of the four posterior series so widely separated as in Pelseneer's Fig. 9 of *Silenia Sarsi*. They always seemed closer together, and more evidently radiating from a central elevation on the septum behind the foot. But too much stress must not be laid on the discrepancies of his diagrams, which are not and do not appear to be intended for exact and complete portraits. In this species a trace of the lateral arrangement of the siphonal muscles remains, while compared with *Cuspidaria* the septal muscles are still in a transitional state.

Cetomya elongata Dall. In the single specimen of this form the branchial areas are composed of lamellæ, between which at their bases are narrow fissures, bridged longitudinally by slender fibers, which act as regulators. In this species the two areas are similar, and resemble those of *Cetomya tornata* Jeffreys, as figured by Pelseneer.

Cetomya albida Dall. In young specimens of this and other species

the membranes of the septum, etc., are extremely delicate. The use of too concentrating hardening agents or the incautious touch of a probe will produce lesions which may be indistinguishable from normal fissures. To make sure that nothing of this sort shall happen, it is necessary to float the soft parts in a cup of water and turn them about with delicate forceps. This is not convenient in all respects for observation, but with time and patience the characters may be made out.

Young specimens of this species show the lamellar areas as usual, with the depressions above them, in the floor of the upper chamber, but the fissures are not open; a fact which leads me to believe that they appear only with maturity. A very delicate membrane seems to hold the distal margins of the lamellæ together, so that a delicate probe passes over without separating them.

General considerations on the nature of the septum in Poromyidæ and Cuspidariidæ.—The facts above and others elsewhere stated indicate that the septum in these groups is essentially a prolongation forward and a specialization of the ordinary siphonal septum. The septum, as pointed out in *Cardium*, may be so prolonged, while the normal gills are fully developed and unconnected with it. In *Verticordia* it may be so prolonged, and may have acquired a conspicuously fleshy texture without fissures, while the gills lie prone upon it, more or less adnate. The muscular apparatus by which the siphons are retracted, and whose normal points of origin are at the side of the ordinary septum, appear to be shifted to its surface. Different species show this process in different stages of completion; and in the only case among the *Poromyas*, where the fibers follow the normal direction in other *Pelecypods*, the septum is destitute of the muscular structure which is so prominent in the other *Poromyas*. In the specialization of the septum the musculation develops from behind. When branchial laminæ are situated upon the septum, and are not simply the ordinary ctenidia in an adnate condition, the addition of a second series is made at the posterior end, and all the branchial areas appear to receive their blood supply from behind.

There is not a particle of evidence to prove that the septal branchial lamellæ of *Poromya* and *Cetoconcha* are homologous with the ctenidia of *Verticordia*, *Lyonsiella*, *Perna* or *Cardium*. The fact that *Cuspidaria* has neither ctenidia nor any specialized laminæ on the septum lends probability to the assumption that the two series represent a parallel among these Pelecypods to the ctenidia and the peripedal laminæ in *Acmæa*, *Scurria*, and *Patella*, among the *Docoglossa*. That is, that the septal laminæ are a new and special development, which functionally replace, but are not homologous with, the original ctenidia. If this view is doubted, the burden of proof lies upon those who call it in question.

It may be asked whether any hypothesis can be suggested by which this peculiar specialization may be accounted for. The law of economy

in development, which calls for the maximum of function with the minimum expenditure of tissue, and the other rule, which associates with greatest vigor of life the most successful oxygenation of the blood, together with the obvious benefits to be derived from temporary protection of the newly hatched larvæ, will enable us to suggest an answer.

The prolongation forward of the siphonal septum, especially in forms with short siphons, like *Poromya* and *Lyonsiella*, will evidently promote successful aeration of the blood by cutting off from the branchial chamber the water of the anal chamber, fouled more or less by the effete products discharged into it. A certain amount of fibrous tissue must be developed to form this septum. It is clear that an economy of tissue would result from the transfer of retractorial functions to the septum and the obsolescence of the lateral retractile musculature. A further economy would result from the utilization of this large sheet of tissue for branchial purposes, and a diminution of the tissue previously expended in the mass of the ctenidia. The habit of the larvæ, so common among Pelecypods, of nestling for safety in the branchial folds, would lead directly to the utilization of the chamber as a refuge. But a close chamber such as we see in *Verticordia* would, from the less pure character of its contained sea-water, be less favorable than one into which the water could be more freely admitted by any means which would not imply an admixture of the foul water with that of the branchial chamber below. A system of orifices like those of *Myonera* would accomplish this. A subsequent development of the muscular tissue of the septum, so that it could operate somewhat after the fashion of a pump and voluntarily frequently renew the water in the anal chamber, would obviously be beneficial. By the effect of stimulation the margins of the orifices thus subjected to repeated strong currents of fresh water would be likely to undergo a specialization of respiratory functions as compared with the rest of the surface of the septum, which would result in something like the tubular gills of *Cetoconcha*, or the lamellæ of *Poromya*.

The gradual diminution of the ctenidia and increase of the area of the siphonal septum is illustrated by such a series as *Lyonsia*, *Lyonsiella*, and *Verticordia*, all of which possess true ctenidia.

The gradual specialization for branchial purposes of the septum after the extirpation of the ctenidia would be illustrated by the series from *Myonera* and *Cuspidaria* to *Cetoconcha* and *Poromya*.

While the above chain of hypothesis harmonizes with the observed facts in a satisfactory manner, it is stated merely as a possible hypothetical explanation, and not as a theory to which the writer must stand permanently committed.

General summary.—Premising that in this article the word *ctenidium* is employed to designate the normal typical gill of Pelecypods, in any of its modifications, as opposed to temporary or local branchial organs of different origin, the facts just reviewed may be briefly summarized.

(1) In many groups of Pelecypods the ctenidia are more or less united behind the foot, so as to divide the peripedal chamber into an upper or anal and a lower or branchial portion. In these cases (*Perna*, *Modiolarca*, for example) there is no important modification of the structure of the gills, and the septum is truly branchial in character, and the siphonal septum takes no part in the formation of the partition.

(2) In other forms, the siphonal septum is extended forward to form a partition either (A) unmodified (*Cardium*), (B) thickened without orifices (*Verticordia*), (C) assuming a retractile function (*Cuspidaria*) with orifices, (D) only partially retractile (*Dermatomya*) with single lateral series of orifices, or (E) with an incomplete double lateral series of orifices (*Cetoconcha*). In these cases the breathing organs may be (A) unmodified ctenidia, (B) depauperated adnate ctenidia, (C) the general surface of the septum without ctenidia or specialized lamellæ, (D) with only specialized flat lamellæ, or (E) with specialized subtubular proliferations. In these cases the structure of the septum appears to be wholly independent of the ctenidia, though in *Verticordia* they are adnate upon its surface.

(3) There is one form (*Lyonsiella abyssicola*) in which the siphonal septum and the ctenidia are stated to be mutually attached, so that the septum may be said to be of a compound formation, though in another species of the same genus (*L. radiata*) the septum is of the kind described in paragraph 1. The first statement stands in need of confirmation.

(4) The orifices in the septum of *Poromya* seem to be closed, or partly closed, in youth, and open with the attainment of sexual maturity.

(5) The anal chamber, as indicated in 1886, seems to fill the office of a marsupium.

(6) The tissues of the septum may therefore be derived from structures diverse in their origin, in some cases ctenidial and anterior, in others siphonal and posterior.

(7) Finally, from these facts it is evident that Dr. Pelseneer's assumption, that the septum is essentially ctenidial in its origin, is unwarranted, and his group *Septibranchia*, as defined by him, is founded on an error of observation. While as a group-name it may be used to indicate features of structure whose origin he misunderstood, yet, from the purely adaptive nature of these features and their variations in forms otherwise closely related, the name has no claims for adoption either in a strictly genealogical or an eclectic system of classification. It may be added, that the "proof" that *Poromya* and *Silenia* (=*Cetoconcha*) are more nearly related to each other than to *Cuspidaria*, which Dr. Pelseneer claims to be his work (*op. cit.*, p. 25), had been published by me more than two years previous to the appearance of his paper, and exemplified in the classification I then proposed; a classification which nothing since published has pretended in any way essentially to

modify. This classification, augmented by the new discoveries of the past three years, may be expressed in brief as follows:

Family *Cuspidariidæ*: abranchiate, siphoseptate, septum foraminate.
Genus *Cuspidaria* (etc.) with long siphons; oral palpi obsolete.
Genus *Myonera*, short siphons; oral palpi absent.
Family *Poromyidæ*: septibranchiate, siphoseptate.
Genus *Poromya*: teeth strong; oral palpi large; foramina of septum slit-like, between the close-set lamellæ arranged in two interrupted longitudinal series; pallial sinus obsolete; surface of shell granular.
Subgenus *Dermatomya*: shell not granular; pallial sinus developed; hinge strong.
Subgenus *Cetomya*: shell granulous; pallial sinus obsolete; hinge teeth obsolete in the adult.
Genus *Cetoconcha*: hinge teeth obsolete in the adult; pallial sinus obsolete; siphoseptum foraminate, the foramina arranged in four longitudinal series, solitary, the subtubular lips filling the office of gills.
Family *Verticordiidæ*: siphoseptate with small adnate ctenidia; oral palpi almost obsolete; septum imperforate.

Lyonsia and probably *Lyonsiella* may be called branchioseptate, and should be referred elsewhere.

Genus **POROMYA** Forbes.

Poromya cymata sp. nov.

Plate VIII, Fig. 4.

Shell small, ovate, inequivalve, the right valve most inflated and larger; hinge of the normal *Poromya* like *P. granulata;* umbo in the right valve high, inflated, prominent; anterior end rounded; posterior end with a narrow, sharp keel radiating from the umbo between two shallow, wide, gently excavated furrows which undulate the margin; surface covered with rather sparsely set granules, coarser toward the margin, finer on the umbo and posterior waves and disposed in radiating lines; left valve (as in *Corbula*) proportionately longer and less high and with deeper excavations where the furrows come to the margin; the furrows are also wider and extend further forward on the valve, which is less inflated than the right valve; the granulations, too, seem more close set and a little more irregular; there is no lunule or escutcheon; the epidermis is pale yellowish, under which the surface seems iridescent; the interior is brilliantly pearly; the muscular scars are faint, the pallial line simple, with some flexuosity near the posterior scar, but too irregular to be termed a sinus; the whole interior shows indications of radiating striæ which appear as marked grooves or crenulations on the basal margin of the valves. Right valve, altitude 10; longitude 9; diameter 3.5mm. Left valve, altitude 8.5; longitude 11; diameter 3mm. These valves are not pairs.

HAB.—At U. S. Fish Commission Station 2762, east of Rio Janeiro, in 59 fathoms, mud bottom; temperature 57°.1 F.

Only detached valves of this handsome and strongly sculptured species were obtained. Its nearest relative is a Korean species represented by an imperfect valve collected by Captain St. John, in the Jeffreys collection. The Korean shell is less strongly furrowed and the furrows are more longitudinal than in the present species. *P. cymata* is notable also for the crenulation, or rather the vertical grooving of the internal basal margin, a feature I do not remember noting in any of the other species. The pallial line is more irregular as it nears the posterior adductor scar than in the type of the genus, but it does not show a definite sinus as in *Dermatomya*. The species is evidently very near the border line and its septum will probably be found to be less muscular than in such species as *P. granulata*.

Subgenus CETOMYA Dall.

Poromya microdonta sp. nov.

Plate VIII, Fig. 6.

Poromya subleris Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 448, 1889; not of Verrill.

HAB.—U. S. Fish Commission Station 2723, in 1,685 fathoms, ooze, about 125 miles eastward from Chesapeake Bay, bottom temperature not taken, but that of the next station, near by, was 36°.3 F.

In this species, by carefully dissecting away the septum, which presented much the same appearance as that of *P. granulata* in Pelseneer's diagram (*op. cit.*, Pl. III. Fig. 7), several interesting facts were disclosed. The posterior lamellæ were not separated by fissures at their base. This seemed evident on an external view, but was made more certain by an inspection of the upper surface of the septum, where these openings, when they exist, are always conspicuous. The anterior areas were fissured, especially near the foot, but less so behind, so that when I first examined this species, taking the extreme delicacy of the membranes into account, and the apparently imperforate character of the posterior areas, I suspected that the fissures were due to tearing or incautious probing. A reversal of the septum and an examination of other species showed, however, that there are variations in this respect, and that Pelseneer had correctly described the conditions which exist in some of them. An interesting feature disclosed by the examination of the septum under transmitted light was, that the blood-vessels which supply the branchial lamellæ appear to reach them from behind, a separate vessel starting from the vicinity of the siphons and running a somewhat irregular course to each of the lamellar areas on each side. There seemed to be no continuation of these vessels anteriorly in front of the areas which they serve. The ovisacs are not lobulated, as in *Myonera*, but more evenly spread over the posterior surface of the visceral mass. The ripest eggs were large and conspicuous. There was no evidence of their extrusion through the covering of the visceral mass, as in *Myonera*, though this may take place later.

Maximum altitude of shell, 11.5; maximum longitude, 10.5; diameter, 9mm. This form has almost exactly the outline and size of *P. sublevis* Verrill, to which I at first referred it. But that species has the typical teeth of *Poromya*, while in this the only tooth in the right valve is a single slender spur-like cardinal, and the left valve is almost edentulous. In its teeth this species agrees much more nearly with *P.* (*Cetomya*) *tornata* than with any of the normal species, and, like that, has a twist in the posterior rostrated part of the shell which I have not observed in any genuine *Poromya*, and which is not mentioned by Verrill in his description of *P. sublevis*, of which I have not had an opportunity of seeing specimens. I can hardly (after seeing many specimens of *Poromya*) believe that such differences in the hinge are not of specific value.

Subgenus DERMATOMYA Dall.

Dermatomya Dall, Bull. Mus. Comp. Zoöl., XVIII, pp. 449, 452, June, 1889.

Dermatomya mactroides Dall.

Plate VIII, Fig. 8.

Poromya (*Dermatomya*) *mactroides* Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 449, June, 1889.

Shell large, stout, strong, with a strong epidermis, olive gray toward the beaks, paler, inclining to greenish, toward the margins in the adult; epidermis raised into wrinkles on the posterior area and folding in over the basal margins; young shell with a few sparse granulations near the anterior and posterior margins, adult without visible granulations, the epidermis mostly shining and the shell showing iridescent through it; the young are subrhomboidal, the adults have the beaks prominent, high, subcentral; the anterior end rounded, the posterior very slightly produced; surface sculptured only with more or less evident incremental lines; lunule and escutcheon are visible on a close scrutiny, though not marginated by a line; the former is cordate, the latter narrow and long; hinge of *Poromya*, strong; ligament short, half internal; interior faintly iridescent, pallial and muscular scars distinct but not emphatic; the pallial line is deeply and rather narrowly sinuated; the basal margin is perfectly plain; altitude of adult shell, 16; longitude, 18; diameter, 12mm.

HAB.—U. S. Fish Commission Stations 2781, 2783, and 2785, on the west coast of Patagonia, on a muddy bottom in 122, 348, and 449 fathoms; bottom temperature 46°.9 to 49°.9 F. Also at Station 2793, in 741 fathoms, mud; bottom temperature 38°. 4F. off the coast of Ecuador.

The superficial resemblance to a small *Mactra* presented by this shell needs no further comment. It is sufficiently evident.

This fine species differs from the typical form of the genus in the absence of the superficial granulations, and in the presence of a deep and strong pallial sinus, which characters indicate that it should form a special section of the group. The hinge is also remarkably coarse and strong.

In the type of *Poromya* the pallial sinus is obsolete; its retractor muscles are either mainly incorporated in the septum, the muscular contractions of which serve to move the siphons, or they are replaced by the septal muscles. In the present species, however, there is a large and strong pallial sinus with its usual muscles, and the septum is consequently only very slightly furnished with muscular fibers, and does not serve to retract the siphons. The valve to the branchial siphon is large, and the palps are enormous. The anterior edges of the anterior palps are notched or papillose toward the median line, a condition not observed in the other species. The foot is pointed and slightly geniculate. There are seven anterior and eight or nine posterior gill lamellæ; the two areas are rather narrow, and their ends closely approach one another near the middle of the foot on each side. In front of the ridge which precedes the large branchial valve, and between it and the foot, are four or five quite prominent elevations of the surface, closely resembling the branchial lamellæ, but with their length in the axial direction of the animal. There are no fissures between these, but they seem very like branchial lamellæ in process of development. Both the longitudinal branchial areas on each side are fissured, and their blood-vessels reach them from behind.

Suborder MYACEA.

Family CORBULIDÆ.

Genus **CORBULA** Bruguière.

Corbula Dietziana C. B. Adams.

This species was obtained at the Abrolhos Islands, near Porto Allegre, Brazil. It extends northward to Cape Hatteras, and was previously known to extend southward only among the Antilles.

Corbula Barrattiana C. B. Adams.

Corbula disparilis Orbigny.

Corbula cymella Dall.

The above mentioned three species were collected at Station 2758, 90 miles southeast from Cape San Roque, in 20 fathoms, shelly bottom, off the Brazilian coast.

Family SAXICAVIDÆ.

Genus **SAXICAVA** F. de Bellevue.

Saxicava arctica Linné.

This well known shell, indistinguishable from Greenland specimens, was collected at Stations 2768 and 2770, off Cape Delgado and Spiring Bay, eastern Patagonia, in 43 and 58 fathoms, sand.

Class SCAPHOPODA.

Order SOLENOCONCHIA.

Genus **DENTALIUM** Linné.

Dentalium megathyris sp. nov.

Plate IX, Fig. 1.

Shell remarkably stout and solid, moderately curved; surface, when not eroded, shining; color yellowish white, generally with some dark extraneous matter lodged in the grooves of the sculpture; anal end circular, small, simple, with a sharp edge, about 2mm in diameter; toward this end the shell is more curved than anteriorly; surface with strong flattened longitudinal threads about 1mm from center to center, the interspaces sharply grooved in rather deep square-sided channels; about the middle of the shells the ribs begin to bifurcate so that the anterior sculpture, though of the same character, is some two or three times as fine as the posterior; in old age the sculpture is interrupted around the aperture; transverse sculpture only of fine incremental lines; oral aperture sharp edged, a little oblique, nearly circular, slightly flattened in an antero-posterior sense; interior milk-white; texture of the shell porcellanous with an external chalky stratum under the smooth exterior, which is frequently much eroded even in life; maximum longitude of shell, 95; diameter of aperture, 17.5; antero-posterior diameter of same, 15.5mm.

HAB.—U. S. Fish Commission Station 2807, near the Galapagos Islands, Pacific Ocean, in 812 fathoms, globigerina ooze, bottom temperature 38°.4 F.; also off Chiloe Island and southwest Chili at Station 2788 and 2,789, in 1,050 and 1,342 fathoms; temperatures 36°.9 and 35°.9 F.

This is one of the finest species of the genus known, and was taken alive in some numbers. The young recalls *D. ceras* Watson, but the shell changes in rate of increase and form of longitudinal ribs as it grows. It is a little straighter near the anal end, and the adult is more funnel shaped, with flatter ribs than in *D. ceras*.

The radula is short, with the formula $\frac{1}{1+1}\frac{1}{1+1}$. The median tooth is wide, subrectangular, arched a little in front. The laterals on each side have a projecting stout cusp; the uncini are flat rhomboidal plates. The whole radula bears a strong resemblance to that of *Entalis striolata*, as figured by G. O. Sars. (Moll. Reg. Arct. Norv., t. I, f. 1, 1*a*.–*c*.) The œsophagus is short; the stomach short and cordate, stuffed with foraminifera. The soft parts, as preserved in alcohol, seem ridiculously small and out of proportion to the massive shell.

Dentalium callithrix Dall.

D. callithrix Dall, Bull. Mus. Comp. Zoöl., XVIII., p. 427, Pl. XXVII., Fig. 10, June, 1889.

This species was collected at Station 2751, south of the island of St. Christopher or St. Kitts, in the West Indies, in 687 fathoms, ooze; temperature at the bottom 39°.9 F.; and at Station 2754, east from the island of Tobago, in 880 fathoms, ooze; temperature 37°.9. It has also been found among the dredgings made at Rio Janeiro many years ago by the Wilkes Exploring Expedition.

Dentalium ensiculus Jeffreys.

D. ensiculus (Jeffreys, 1877) Dall, Bull. Mus. Comp. Zoöl., XVIII., p. 428, Pl. XXVII. Fig. 12, 1889.

D. didymum Watson, 1879.

D. sigsbeeanum Dall, 1881.

Collected at Station 2644, off Cape Florida, in 193 fathoms, sand; temperature 43°.4.

This species is common to the north Atlantic, but so far has not been found south of the Antilles.

Dentalium ceras Watson.

Collected at U. S. Fish Commission Station 2763, in 671 fathoms, globigerina ooze, temperature 37°.9, 240 miles east from Rio Janeiro. This locality helps to bridge the gap between the Pacific station west of Valparaiso, where the *Challenger* found it, and the stations in the Antilles and the Gulf of Mexico, where it was obtained by the *Blake.*

Dentalium candidum Jeffreys.

This species was found with the preceding and also at Station 2760, 90 miles north from Ceara, Brazil, in 1,019 fathoms; temperature 39°.4 F. It was obtained by Jeffreys in the northeast Atlantic, in 410 to 1,750 fathoms, and on the northeast coast of the United States, on the Carolina coast and northward, by the U. S. Fish Commission, in 843 to 1,309 fathoms. The present localities greatly extend its southward range.

This is the *D. solidum* of Verrill, and I have received it from a correspondent in Europe, under the name of *D. ergastricum* Fischer, from deep water in the Bay of Biscay.

Dentalium perlongum Dall.

Collected at Station 2751, off St. Kitts, West Indies, in 687 fathoms, ooze, temperature 39°.9; at Station 2754, east from Tobago, in 880 fathoms, temperature 37°.9; and at Station 2760, 90 miles north of Ceara, Brazil, in 1,012 fathoms, coral, temperature 39°.4 F. It ranges northward to the Carolina coast.

Dentalium Gouldii Dall.

D. Gouldii Dall, Bull. Mus. Comp. Zoöl. XVIII, p. 424, Pl. XXVI, Fig 4, June, 1889.

This extends from South Carolina to the Antilles and southward to Station 2762, east from Rio Janeiro, in 59 fathoms, mud; temperature 57°.1 F.

Genus **CADULUS** Philippi.

Cadulus albicomatus sp. nov.

Plate IX, Fig. 8.

Shell resembling *C. spectabilis* Verrill, but larger, with a less prominent equator, more compressed in an antero-posterior direction, and with the anal opening produced at the sides and roundly excavated in front and behind instead of notched laterally and produced medianly. Color milk-white; incremental sculpture indicated only by more or less translucent rings in the shell substance; longitudinally sculptured by extremely fine sharp grooves with equal interspaces which cover the whole of the shell; curvature moderate, nearly uniform, slightly more marked near the anal end; the whole shell distinctly compressed though not flattened, except below the oval aperture, where the shell is impressed, making a shallow sulcus extending backward nearly two millimeters, and in front arching the margin so that the perfect aperture is distinctly reniform with sharp thin edges. There is no swollen equatorial girdle; the greatest diameter is near the posterior end of the above-mentioned sulcus, whence the shell tapers evenly backward; aperture slightly oblique; anal aperture nearly circular, concavely arched, but not notched in front and behind; longitude of shell on its dorsal chord, 24; perpendicular to the chord, 2; diameter of oval aperture, 3; antero-posterior diameter, 1.5; diameter of anal aperture, 1; maximum diameter of shell, 3.4; antero-posterior diameter of shell, 3^{mm}.

HAB.—U. S. Fish Commission Station 2792, in 401 fathoms, mud; off Manta, Ecuador; temperature 42°.9 F.

This species was obtained about 40 miles south of the equator in west longitude 81°. It is one of the largest and finest species of the genus, and the only one known to me which is distinctly longitudinally sculptured.

Cadulus quadridentatus Dall.

Found at Station 2765 in 10½ fathoms, sand, off Rio de la Plata. It extends northward to Cape Hatteras and has also been found at Fernando Noroñha and the west coast of Florida in 7 to 50 fathoms.

Cadulus tumidosus Jeffreys.

Dredged at Station 2760, 90 miles north from Ceara, Brazil, in 1,019 fathoms, broken coral, temperature 39°.4 F. It has been dredged in deep water in several parts of the North Atlantic, the Bay of Biscay, and near the Canaries. The specimens have been compared with those in the Jeffreys collection.

Class GASTROPODA.

Subclass ANISOPLEURA.

Superorder EUTHYNEURA.

Order OPISTHOBRANCHIATA.

Suborder TECTIBRANCHIATA.

Family ACTÆONIDÆ.

Genus **ACTÆON** Montfort.

Actæon delicatus Dall.

A. delicatus Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 41, Pl. XVII, Fig. 5, 1889.

This Antillean species was obtained at Station 2771, off Point Gallegos, eastern Patagonia, in 50½ fathoms, sand, temperature 49°.4. This discovery carries its known range southward nearly the whole length of the continent of South America.

Actæon curtulus sp. nov.

Shell small, short, subglobular, white, not polished; surface covered with sharp, deep, close set, spiral grooves, minutely punctate at bottom; whorls three, beside the prominent, polished, smooth, globular, sinistral nucleus; suture distinct, not channeled; outer lip thin, simple; body with a thin wash of callus; pillar short, thin, very much twisted, so that its outer edge presents a plait-like appearance, while the shell seems almost canaliculate, though the pillar is continuous with the basal margin; above the twisted edge and separated from it by a deep channel is a second less prominent plait; altitude of shell, 3; diameter, 2^{mm}.

HAB.—West coast of Patagonia, at Station 2783, in 122 fathoms, mud, temperature 48° F.

This little shell is mostly comprised in the last whorl and appears mature. It recalls *Stilifer*, or a small snow-white *Pedipes*, as much as anything, and is different from any recent species of the group I have seen.

Actæon perconicus sp. nov.

Plate XII, Fig. 7.

Shell pear-shaped or conic, with rather acute spire, polished ivory white, with four whorls beside the nucleus; transverse sculpture of incremental lines; spiral sculpture of three to five close-set, sharp, punctate grooves in front of the suture, more distant anteriorly, and a similar but more numerous and uniformly spaced series just behind the

pillar, behind which again are four or five widely separated similar grooves, the posterior near the periphery; between them and near the periphery, as well as behind it, are no grooves or but faint spiral obsolete striæ; suture distinct but not channeled; last whorl much the largest; outer lip straight, simple, slightly thickened; body with a moderate deposit of callus; pillar as in *A. curtulus*, but less strongly twisted and with the plait and recurved margin subequal; although the margin is continuous, there is a rather deep sulcus behind the anterior end of the pillar, corresponding to a groove, which bounds the columella callus; longitude of shell, 5; latitude, 3; longitude of aperture, 3mm.

HAB.—Near the Galapagos Islands, in the Pacific, in 812 fathoms, ooze; temperature 38°.4 F.

This shell and the last species seem to stand in an intermediate position between *Actæon* of the typical kind and *Cinulia*. If the outer lip should eventually become much thickened, of which, however, there is no satisfactory evidence, these shells might be referred to *Cinulia*. If the *A. curtulus* recalls *Pedipes mirabilis* Muhlfeldt in its form and sculpture, *A. peiconicus* recalls *P. elongatus* Dall.

Family TORNATINIDÆ.

Genus **UTRICULUS** Brown.

Utriculus domitus Dall.

Collected at Station 2751, south from St. Kitts, in 687 fathoms, ooze; temperature, 39°.9 F.

Family SCAPHANDRIDÆ.

Genus **SCAPHANDER** Montfort.

Scaphander nobilis Verrill.

Dredged at Station 2754, east from Tobago, in 880 fathoms, ooze; temperature 37°.9 F. It extends northward to Delaware Bay, in deep water.

Scaphander interruptus sp. nov.

Plate XII, Fig 12.

Shell in many respects resembling *S. lignarius* and best described by comparison with it; shell of a livid or grayish straw-color, not the yellow or reddish brown of *lignarius;* the tip of the spire is smaller in proportion and more pointed; the axis is pervious as in *lignarius*, but the perforation is more cylindrical and does not become funnel-shaped as the shell enlarges to maturity; the shell averages more slender; the callus on the body is not reflected so far and especially on the anterior part of the pillar; the grooves of the surface in *S. lignarius*, without

exception, are continuous, the punctures being arranged along their channels; in *S. interruptus* the spiral sculpture is composed of rows of short or longer punctuations or grooves, which do not unite to form a continuous line except close to the columella in front, and here rather as the result of crowding and over-lapping; these short grooves are not punctate at bottom as in *S. lignarius*, but are apt to alternate stronger and weaker, and are more close-set than in *lignarius* of the same size; maximum longitude of shell, 33; maximum latitude of shell 17.5; of aperture, 13.5mm.

HAB.—Station 2788, west coast of Patagonia, in 1,050 fathoms, mud, temperature 37°; and Station 2807, near the Galapagos Islands, in 812 fathoms, ooze, temperature 38°.4 F.

The specimens have been carefully compared with a very large series of *S. lignarius* in the Jeffreys collection.

Subgenus SABATIA Bellardi.

Sabatia bathymophila Dall.

S. bathymophila Dall (1881), Bull. Mus. Comp. Zoöl. XVIII, p. 53, Pl. XVII, Figs. 9, 9*b*. 1889.

This species, which was previously known to extend in deep water as far north as Fernandina, Florida, was obtained at Station 2744, 100 miles east from Delaware Bay, in 554 fathoms, mud; and at Station 2754, east from Tobago, in 880 fathoms, ooze; temperatures 38°.9 and 37°.9 F.

Genus **CYLICHNA** Lovén.

Cylichna Verrillii Dall.

This species was also obtained at Station 2754.

Genus **ATYS** Montfort.

Atys Sandersoni Dall.

A ? Sandersoni Dall (1881), *op. cit.* XVIII, p. 54, Pl. XVII, Fig 7.

This species was collected at Station 2758, 90 miles southeast from Cape San Roque, in 20 fathoms, shelly bottom, temperature 79°.1 F.

Family BULLIDÆ.

Genus **BULLA** Linne.

Bulla Krebsii Dall.

B. Krebsii Dall, *op. cit.*, XVIII, p. 56, 1889.

This species described from Guadalupe, West Indies, was collected at Station 2754, east from Tobago, in 880 fathoms, ooze; temperature 37°.9 F.

Order PULMONATA.

Suborder BASOMMATOPHORA.

Superfamily PETROPHILA.

Family SIPHONARIIDÆ.

Genus **SIPHONARIA** Sowerby.

Siphonaria ferruginea Reeve.

This species, which reaches as far north as Vera Cruz, Mexico, was obtained at the Abrolhos Islands, off Porto Allegre, Brazil.

Suborder STYLOMMATOPHORA

Superfamily GEOPHILA.

Family HELICIDÆ.

Genus **HELIX** Linné.

Helix lactea Müller.

This well known South European species, being an article of diet with the Italians, has been introduced into those parts of South America where Italian emigration has been directed. At Montevideo it was collected in great abundance, not differing from Mediterranean specimens, except that the shells averaged somewhat darker in color, on the upper portion, than the European specimens with which I was able to compare them.

Superorder STREPTONEURA.

Order CTENOBRANCHIATA.

Suborder ORTHODONTA.

Superfamily TOXOGLOSSA.

Family TEREBRIDÆ.

Genus **TEREBRA** Lamarck.

Section ACUS H. & A. Adams.

Terebra (Acus) benthalis Dall, var. **nodata** Dall.

Plate v, Fig. 9.

Shell small, slender, polished, yellowish white, with a blunt, somewhat inflated nucleus, and thirteen (or more) somewhat flattened whorls; suture distinct, appressed, the presutural band narrow, bounded in front by a rather wide, shallow sulcus and ornamented by obscure rounded pustules, from ten to fifteen on each whorl; immediately in front of the

sulcus is a row of larger and more prominent nodulations, the number on each whorl being the same as on the band; there are also a few transverse, sometimes sharp but generally obscure, ridges crossing the whorls; spiral sculpture of fine obscure lines, often obsolete, but pretty evenly distributed over the surface; aperture (broken) narrow, outer lip simple; pillar simple, without any marginal keel; canal narrow, not exhibiting any fasciole; base attenuated in front, gently rounded to the periphery. Maximum longitude of shell, 18.5; maximum latitude, 4mm.

HAB.—U. S. Fish Commission Station 2750, off St. Bartholomew, West Indies, in 496 fathoms, fine gray sand; bottom temperature 44°.4 F.

The first three apical turns of this shell are smooth, then the sculpture above described begins. The soft parts were not obtained. It resembles the shell described in the *Blake* Report under the name of *benthalis* and is doubtless a variety of it, in which the longitudinal sculpture has become faint and the nodulations intensified.

Family CONIDÆ.

Genus **CONUS** Linné.

Conus Cleryi Reeve.

This species was collected at Station 2762, east from Rio Janeiro, in 59 fathoms, living; and at Station 2765, off the Rio de la Plata, in latitude 36° 43′, in 10½ fathoms, sand; temperature 59°.1 F.

The examination of these specimens leads me to believe that my suggestion in the *Blake* Report that *C. Villepinii*, F. & B., might be identical with *C. Cleryi*, is not likely to prove correct. They seem much more distinct than the figures of the species would indicate.

Family PLEUROTOMIDÆ.

Genus **PLEUROTOMA** Lamarck.

Subgenus LEUCOSYRINX Dall.

Leucosyrinx Goodei sp. nov.

Plate VI, Fig 1.

Shell large, thin, white, with a tinge of pale orange in the throat and on the pillar; whorls eight (or more), nucleus wanting in the specimens; surface generally slightly eroded, glistening when perfect; spiral sculpture below the periphery of narrow shallow grooves separating wider, half obsolete threads; at the periphery is an obtuse carina which is sharper on the early whorls; behind this is a wide shallow sulcus, behind which the whorl rounds to the distinct but unchannelled suture; on the upper or posterior part of the whorl the fine spirals are perceptible but fainter than in front of the periphery; transverse sculpture only of incremental lines; aperture elongated moderately wide; anal

notch wide, rounded; fasciole slightly raised, not strongly differentiated; body with a thin transparent glaze; pillar strong, obliquely truncate, flaring, almost pervious, anteriorly more or less tinged with pale orange; canal long, thin, shallow, slightly recurved; outer lip prominent below the periphery, thin, sharp; maximum longitude of shell, 80; maximum latitude, 35mm.

Operculum at first shaped like that of *Volutopsis*, the nucleus apical but the succeeding growth showing a tendency to a slight spirality; with subsequent growth this becomes inclosed by additions made all around the margin, and the adult operculum appears buccinoid, having a buccinoid outline, in the lower right hand part of which the nuclear part is inclosed. This singular form of operculum is not a deformity, but is common to several of the species of *Leucosyrinx* in which I have been able to examine this appendage. It is a feature which by gradual stages, represented by different species, approaches the normal Pleurotomoid operculum.

HAB.—U. S. Fish Commission Station 2788, in 1,050 fathoms, green mud, off the northwest coast of Patagonia, south latitude 45° 35′, west longitude 75° 55′, 3 degrees south of Chiloe Island; bottom temperature 36°.9 F.

This fine species recalls, in its general form and appearance, the inoperculate *Mangilia* (*Aforia*) *circinata* Dall, from Bering Strait and the Arctic Ocean. The soft parts were destroyed by desiccation before reaching me.

Leucosyrinx (Goodei var.?) persimilis sp. nov.

Plate VI, Fig. 3.

Shell resembling the preceding species except in the following particulars: It is more slender and of pure white, the peripheral carina is more anterior, the anal notch consequently wider, and the fasciole is not elevated; the peripheral carina is narrower and more distinct, but the sulcus behind it is much fainter; the pillar is thinner and so coiled as to be axially pervious to the very apex: the canal is not quite so shallow, and there is no color on the pillar or in the throat; the spiral sculpture is finer and more distinct. Maximum longitude of shell, 80; maximum latitude, 30mm.

Operculum slightly more elongate, but in structure like that of the preceding species.

HAB.—U. S. Fish Commission Station 2791, latitude 38° 8′ S., longitude 75° 53′ W., off the southwest coast of Chili, in 677 fathoms, mud; bottom temperature 37°.9 F.; and Station 2793, in 741 fathoms, off the coast of Ecuador, in north latitude 1° 03′, west longitude 80° 15′; bottom temperature 38°.4 F.

This species is remarkably like the *L. Goodei*, but in a fair series the differences seem constant enough to deserve a name. The soft parts are whitish; the tentacles stout and blunt; there are no eyes or pedi-

cels; the foot is wide and double edged in front, rounded behind; there is a well-marked purpuriferous gland on the dome of the mantle; the penis is very large and of the usual form, with the terminal papilla retractile; the gills prominent and normal as well as the osphradium.

Leucosyrinx tenoceras Dall.

L. tenoceras Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 76. Pl. XXXVI, Fig. 5, June, 1889.

This species, which extends northward to Cape Fear, North Carolina, was collected by the *Albatross*, at Station 2751, south of St. Kitts, in 687 fathoms, ooze; at Station 2754, east from Tobago, in 880 fathoms, ooze; and at Station 2763, 240 miles east by south from Rio Janeiro, in 671 fathoms, ooze; temperatures 37°.9 to 39°.9 F.

Leucosyrinx Verrillii Dall.

L. Verrillii Dall (1881), *op. cit.*, XVIII, p. 75, Pl. X, Fig. 5, 1889.

This fine species, which has the same northward range as the preceding, was found with it at Station 2751, and also at Station 2761, 150 miles south from Bahia, Brazil, in 818 fathoms, ooze; temperature 38°.9 F.

Subgenus PLEUROTOMA s. s.

Pleurotoma exulans sp. nov.

Plate V, Fig 7.

Shell solid, of a yellowish chocolate-brown, strongly sculptured, with eight or nine whorls, the tip eroded in all the specimens; whorls rounded, the region of the fasciole in front of the closely appressed suture flattish, constricted, and polished; transverse sculpture in front of the fasciole (on the penultimate whorl) of about fourteen short, stout, obliquely set riblets, which coronate the whorl and do not reach the suture in front; spiral sculpture of rather narrow shallow grooves, separating slightly-raised flattish, rather wider, threads; the last are finest on the fasciole and somewhat coarser near the canal, but tolerably uniform over the entire surface; notch rather wide, not very deep, rounded, and half way between the suture and the posterior ends of the peripheral riblets; outer lip thin, simple, produced in the middle; canal rather well defined, not very long; pillar obliquely trimmed off in front, of a creamy brown, with a thin polished glaze; axis not pervious; canal rather deep, flaring a little anteriorly. Maximum longitude of shell, 32; maximum latitude, 13^{mm}.

Operculum elongate pyriform, thin, straight, with an apical nucleus, somewhat concave.

HAB.—U. S. Fish Commission Station 2808, near the Galapagos Islands, in the Pacific Ocean, in 634 fathoms, coarse sand; bottom temperature 39°.9 F.

This fine species borders on the subgenus *Leucosyrinx*, but has the operculum, solid habit, and strong sculpture of *Pleurotoma* as restricted.

Subgenus GENOTA H. & A. Adams.

Section DOLICHOTOMA Bellardi.

Genota Carpenteriana (Gabb).

Pleurotoma (Surcula) Carpenteriana Gabb., Proc. Cal. Acad. Sci., III, p. 183, 1865.

HAB.—Monterey, Gabb. Santa Barbara Islands, Cooper; U. S. Fish Commission Station 2838, in 44 fathoms, mud, off Cerros Island, Lower California.

This interesting species, of which but few specimens are known, belongs to the section *Dolichotoma*, of which the type is the fossil *Pleurotoma cataphracta* of Brocchi. This form has a rather thick, stout, blackish operculum, recalling that of *Conus*, but of which the apical point is frequently broken or worn away. The scar on the inner side of the operculum is concentric and strong, but covers only the wider part of the appendage. This section of the *Pleurotomidæ* is frequently furnished with obscure thickened ridges on the pillar; they can be found in most specimens by cutting into the apical whorls even if the shell has no indication of ridges at the aperture.

The foot of this species is narrow, double-edged, and truncate in front, not auriculate, moderately pointed behind; the sides of the foot and surface of the body are irregularly dotted with small, and larger, round pustular elevations. The animal has a purpuriferous gland, and in the case before me, in dying, the fluid expelled from this gland appears to have dyed the whole body of the animal deep purple, which, under the action of the alcohol and time, has become largely brownish. The tentacles are wide and small, with a small, well defined eye on the outer angle. The verge is small, subcylindrical, except near the tip, which is (naturally or otherwise) somewhat flattened, clavate, and decidedly phalliform, terminating in a large subconic smooth papilla with a thickened girdle at its base. The gills and osphradium as usual. The proboscis is short, much attenuated anteriorly. There is a large poison gland situated as in *Bela*, and the individual teeth are much like those of *Bela;* for instance, those of *B. Gouldii* as figured by Verrill (Trans. Conn. Acad., V, Pl. LVII, Fig. 6*a*), but with the base of insertion less deeply notched than in that species, and with a slight angulation, not a barb, near the point.

Genus DRILLIA Gray.

Drillia Harfordiana Reeve.

This species, which reaches at least as far north as Vera Cruz, Mexico, was collected at the Abrolhos Islands, near Porto Allegre, Brazil.

Drillia pagodula Dall.

D. pagodula Dall, *op. cit.*, XVIII, p. 90, Pl. XIII, Fig. 6, 1889.

This species was also collected at the Abrolhos Islands. It is common to the Antilles and the Gulf of Mexico, and has been found on the west coast of Florida, in 50 fathoms.

Genus **MANGILIA** (Risso) Fischer.

Subgenus MANGILIA Risso.

Mangilia antonia Dall.

Plate v, Fig. 11.

Mangilia antonia Dall, Bull. Mus. Comp. Zoöl., IX, p. 59, August, 1881; XVIII, p. 116, Pl. X, Fig. 4, Pl. XI, Fig. 11, 1889.

HAB.—Gulf of Mexico to the Antilles, in deep water. Station 2751, south of St. Kitts, in 687 fathoms, ooze; and Station 2754, east of Tobago, in north latitude 11° 40′, west longitude 58° 33′, in 880 fathoms, ooze; temperatures 38° to 40° F.

The figures of this species heretofore given having all been made from young and immature specimens, it was thought well to figure the complete adult shell from some fine specimens collected near St. Kitts.

The specimen figured measures 18^{mm} in length; the largest (but not perfect) specimen obtained must have reached a length of 23^{mm}.

Mangilia exsculpta Watson.

M. exsculpta (Watson, 1882) Dall, *op. cit.*, XVIII, p. 117, Pl. XI, Fig. 9, 1889.

Antilles, *Challenger* and *Blake*, collected by the *Albatross* at Station 2750, off St. Bartholomew, West Indies, in 496 fathoms, sand; Station 2751, south of St. Kitts, in 687 fathoms, ooze; and Station 2754, east from Tobago, in 880 fathoms, ooze; temperatures 37°.9 to 44°.4 F.

This is a very peculiar looking shell. The specimen figured in the *Blake* report is only a young specimen. Those obtained by the *Albatross* were much larger and finer.

Subgenus CALLIOTECTUM Dall.

Shell with a vernicose epidermis, short, undifferentiated canal and no anal notch or fasciole; operculum with apical nucleus, increasing like that of *Fusus*, but curved instead of straight, though not coiled; animal blind, with a short sac-like proboscis, with no teeth or poison gland. Type *C. vernicosum* Dall, abyssal.

Calliotectum vernicosum, sp. nov.

Plate v, Fig. 8.

Shell slender, fusiform, covered with a brilliant chestnut-brown, closely adherent epidermis; whorls seven, without the nucleus, the tip more or

less eroded in all the specimens, though living when taken; whorls slightly rounded, not inflated; sculpture chiefly of fine, subequal, flattened, narrow, slightly flexuous transverse plaits, which on the earlier whorls reach forward to the suture, but on the later ones become obsolete near the periphery, and tend to disappear altogether near the aperture on the last whorl of the adult shell; these plaits are separated by narrower, rather deep grooves, and end at the suture behind rather bluntly, though they can hardly be said to coronate it; there are thirty-five or forty of the plaits on the penultimate whorl; suture very distinct, slightly channeled, but not deep; there is no anal fasciole; the aperture is shaped like a melon-seed, the outer lip evenly arched, projecting somewhat in front of the periphery, not thickened or reflected, and with no constriction for a canal; body and pillar without callus; the columella straight, very slender, not recurved; siphonal notch extremely shallow, hardly differentiated from the aperture; interior of the aperture polished, smooth, dark brown, the pillar livid white or flesh color; siphonal fasciole, none; lines of growth not prominent, the surface showing obscure faint spiral striæ or scratches, but no spiral sculpture. Maximum longitude of shell, 48; maximum latitude, 19mm.

HAB.—Station 2793, off the coast of Ecuador, in 741 fathoms, mud, and Station 2807, near the Galapagos Islands, in the Pacific, in 812 fathoms, coral mud; temperatures in both cases 38°.4 F.

The first mentioned specimen was collected with *Leucosyrinx persimilis* and *Pleurotomella cingulata*.

There is between the internal aragonitic layer and the epidermis a rather thick layer of a cretaceous nature easily eroded, and the action of solvents upon this even in living specimens is extremely marked. The operculum is thin, yellowish brown, with strong growth lines and a large surface of attachment. It reaches a length of 10mm and a breadth of 6mm. It is shaped like that of *Fusus*, but more curved, and varies somewhat in form in different specimens. The nucleus is apical.

The soft parts are mostly yellowish white. There is a purpuriferous gland alongside the distal part of the intestine which ejects a dark rose-colored dye. The head is wide, the tentacles broad, flattened, and connate at the median sinus. The gills, osphradium, and siphon are as usual. The foot is wide, rounded-acute behind, double-edged and slightly auriculate in front. The proboscis is small and short, with large salivary glands whose axis carries a greenish streak. There is no poison gland or dental sac. The animal appears to be edentulous. The verge is large, stout, a little flattened, with its tip obliquely truncate, leaving a granulous oval area at the upper extreme of which is a small conical papilla. The anal orifice is not prominent. The surface exudes an abundant sticky mucus.

This very beautiful and remarkable shell is Pleurotomoid in its characters, though it wants the anal notch and fasciole. Although the operculum is arcuate it is not coiled upon itself. The figure, though accu-

rate as far as the form is concerned, gives very little idea of the beauty of the brilliant brown epidermis and sharply incised sculpture.

Subgenus PLEUROTOMELLA Verrill.

Pleurotomella cingulata sp. nov.

Plate VI, Fig. 2.

Shell large, fusiform, of a rich reddish brown, deepest on the pillar, with a closely adherent, very thin, polished epidermis; whorls seven, without the nucleus, which is lost in the specimen, while the outer coat of the apical whorls is much eroded; whorls full and rounded, suture distinct, not appressed or channeled; transverse sculpture only of fine inconspicuous lines of growth; spiral sculpture of two sorts: first, a fine, sharp, slightly irregular striation, which covers the whole surface; secondly, of revolving elevated cinguli, of which three on the periphery are more widely and deeply separated and more elevated than the others; these three have interspaces equal to or wider than themselves; on the last whorl in front of the periphery the cinguli are flat-topped little elevated wide bands with narrower interspaces, this sculpture becoming obscure toward the canal; above the periphery is one well-marked cingulum slightly turreting the whorl which inclines from it to the suture in a flattened manner; aperture pointed in front, wider behind; pillar simple, perfectly straight, anteriorly attenuated; body and pillar with a thin dark brown glaze; outer lip very thin, sharp, crenulated by the outside sculpture, which also grooves the interior; notch shallow, wide; fasciole hardly visible; canal short, wide, hardly differentiated, straight. Altitude of shell 73; maximum diameter 30^{mm}.

HAB.—U. S. Fish Commission Station 2793, off the coast of Ecuador, in 741 fathoms, mud; bottom temperature 38°.4 F.

The soft parts of this species were preserved, but had been so hardened that the shell was nearly ruined in the effort to extract them. The surface is rather rugose, of a rusty brownish color; the foot is narrow, double-edged, and slightly auriculate in front, rather pointed behind. The tentacles are very short and stout, with no traces of eyes or peduncles.

The proboscis and all its appendages are absent, probably, being extended at the moment of capture, they were torn out by the edge of the dredge. The gill and osphradium are as usual.

I may mention here that in this, as well as nearly all the other cases of abyssal shells with well marked coloration, the specimen, though kept in the dark, has faded rapidly. It is now mostly of a pale chocolate-and-milk color, except at the points where it touches the bottom of the paper tray in which it is kept, or on the columella under the glaze.

Pleurotomella argeta sp. nov.

Plate VI, Fig. 5.

Shell polished, short-fusiform, snow white, eight-whorled; nucleus eroded in the specimen; whorls full, appressed in front of the suture, elsewhere gently rounded; transverse sculpture of delicate incremental lines; spiral sculpture of obscure almost microscopic striæ and a few close set extremely fine threads on the canal; aperture elongated; anal notch very shallow, rounded; leaving only a faint slightly flattened fasciole; outer lip sharp, simple, arched well forward, especially anteriorly; body without callus; pillar thin, white, short, slightly twisted; canal short, very wide, hardly differentiated; maximum longitude of shell 43; maximum latitude 20^{mm}.

HAB.—U. S. Fish Commission Station 2807, in 812 fathoms, mud, near the Galapagos Islands; bottom temperature 38°.4 F.

The characters of this species are as simple as possible, yet a more elegant and delicate shell can hardly be imagined.

The soft parts are yellowish brown and agree externally in all respects with those of the preceding species. Like that, it was impossible to extract them without wholly destroying the shell, as they had been placed in alcohol so strong as to make them as hard and tough as sole-leather. In most *Pleurotomidæ* there is very little if any muzzle between the tentacles; at least when the proboscis is wholly retracted the inner bases of the tentacles, somewhat vertically flattened, are connate at a shallow sinus in the middle line. In the present and the preceding species, however, the tentacles are widely separated and cylindrical, and there is a muzzle which is longer than the tentacles, when both are contracted in alcohol, into the center of which the proboscis is retracted and which has a flattish end almost as in *Litorina*. Something of the sort is found in *Conus* if the figures are to be believed. More investigation in regard to this character is required.

Pleurotomella (Gymnobela) agonia sp. nov.

Plate VI, Fig. 4.

Shell small, thin, bright yellow-brown, with six full and rounded whorls, the nucleus lost, but without doubt of the *Sinusigera* type; spiral sculpture in front of the fasciole of numerous sharp elevated threads with wider interspaces, between each pair of which, except on the canal, are one or two smaller intercalary threads; on the fasciole there are only a few comparatively faint threads, which do not rise above the transverse sculpture, while on the body the spiral sculpture is predominant though minutely undulated by the other; the transverse sculpture is composed of numerous fine, rounded, somewhat elevated threads with wider interspaces, forming a series of elegant concavely arched ripples on the anal fasciole, beyond which they become fainter,

closer, and obscure, being over-ridden by the spirals which they minutely undulate; the fasciole is slightly impressed and extends to the suture, which is distinct but not channeled; the notch is shallow and gently rounded; the outer lip arched forward, sharp; the body covered with a thin glaze, in the aperture; the pillar thin, twisted, not pervious; canal short, distinct; maximum longitude of specimen 16; maximum latitude 8mm.

Hab.—Stations 2807 and 2808, near the Galapagos Islands, in the Pacific, in latitude 0° 24′ south and longitude 89° 6′ west, in 812 and 634 fathoms, globigerina ooze and coral sand; bottom temperature 38°.4 to 39°.9 F.

This pretty little species is much like *P. engonia* Verrill, from deep water off the New England coast, but differs from it in having a finer and more elegant sculpture, rounder whorls, without the prominent angle on the shoulder of *P. engonia*, a narrower fasciole inclined to the suture at a greater angle, and a narrower and more differentiated canal. In *P. engonia* the ripples on the fasciole are strongest near the suture and are not very regular, while in the present form their regularity is conspicuous and they extend without weakening entirely across the fasciole.

Pleurotomella Agassizii Verrill, var. permagna.

Hab.—Station 2734, 124 miles southeast of Delaware Bay, alive, in 841 fathoms, soft mud, temperature 38°.5; and Station 2754, east of Tobago, in 880 fathoms, ooze, north latitude 11° 40′ and west longitude 58° 33′; temperature 37°.9 F.

This fine form resembles *Pleurotomella Agassizii* in general characters, and even in the rosy-brown tint of the columella, but in a specimen of each, with the same number of whorls, we find *P. Agassizii* has a length of 28 and a maximum breadth of 12.5mm, while the variety *permagna* has a length of 35 and a breadth of 17.5mm. Some specimens of *P. permagna* reach a length of 47 and a breadth of 22mm. The number of transverse riblets on the last whorl varies in both species; in *P. permagna* there are eighteen to thirty. I have not seen any of the typical *P. Agassizii* with more than twenty ribs.

P. permagna differs from *P. Bairdii* in just the characters, except size, that *P. Agassizii* does, and from *P. Agassizii* it is distinguished only by its much greater size. The two may be distinct species or they may be two races of one species. Knowing the great variability of abyssal shells, I prefer to take the latter view for the present.

Pleurotomella suffusa sp. nov.

Plate xii, Fig. 10.

Shell small, slender, fusiform, the pillar suffused with yellowish pink, the exterior white, with a thin, pale epidermis and seven or eight whorls, without counting the nucleus; specimen somewhat eroded on the upper

whorls, with indications of a shoulder or carina on the three whorls following the nucleus; suture slightly irregular, appressed, distinct, not channeled; spiral sculpture of fine threads, alternately larger and smaller, pretty uniform over the whole surface, with narrower interspaces, this sculpture fainter on the sutural side of the fasciole; transverse sculpture of faint, irregular, sharp-edged plications, strongest near the suture and on the obscure angle just in front of the fasciole, elsewhere nearly obsolete; fasciole very slightly impressed; notch very shallow; aperture long, narrow, pointed behind; outer lip sharp, arched forward; canal distinct, wide; pillar rosy, attenuated in front; axis almost pervious; body with a thin glaze over a slightly excavated space; nucleus lost; soft parts of the subgenus; maximum longitude of shell, 31.5; maximum latitude, 11.5mm.

HAB.—Station 2807, near the Galapagos Islands, Pacific Ocean, in 812 fathoms, mud; temperature 38°.4 F.

This species, though more slender and much more finely striated, recalls the slender varieties of *P. Agassizii*, though altogether destitute of the strong ribbing and sutural plications. None of the *P. Agassizii* have quite such a taper spire, yet in a general way the two forms belong to the same section of the group. Only one living specimen of the *P. suffusa* was obtained.

Subgenus GLYPHOSTOMA Gabb.

Glyphostoma gratula Dall.

G. gratula Dall (1881), *op. cit.*, XVIII, p. 110, Pl. XII, Fig. 10.
Pleurotoma (*Drillia*) *incilis* Watson.

Collected by the *Albatross* at Station 2750, off St. Bartholomew, West Indies, in 496 fathoms, sand; temperature 44°.4 F.

Genus **BORSONIA** Bellardi.

Subgenus CORDIERIA Rouault.

A finely spirally striate, white *Cordieria*, with two plaits, an undulated anterior border to the anal fasciole, the canal long and slender, with a constriction in front of the short body whorl, was collected with the preceding. The last whorl measured 17.5 by 5.5mm. The spire was entirely deficient, so that it can not be described, though the occurrence of the species is worth noting.

Superfamily RHACHIGLOSSA.

Family OLIVIDÆ.

Genus **OLIVELLA** Swainson.

Olivella floralia Duclos.

Collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms.

Olivella jaspidea Gmelin.

Collected at Stations 2764, 2765, and 2766, the southernmost being off the Rio de la Plata and the depths 10 to 12 fathoms.

Olivella bullula Reeve.

Collected at Stations 2754, 2756, and 2768, the southernmost being off Cape Delgado, eastern Patagonia, and the depths varying from 43 to 880 fathoms. The specimen from shallow water was dead.

Genus **ANCILLARIA** Lamarck.

Ancillaria Tankervillei Swainson.

Young and dead specimens of this species were collected at Stations 2762 and 2764, in 11½ to 52 fathoms, off the coast of Brazil and the Rio de la Plata.

Family MARGINELLIDÆ.

Genus **MARGINELLA** Lamarck.

Marginella cineracea Dall.

Plate XI, Fig. 6.

M. cineracea Dall, Bull. U. S. Nat. Mus., No. 37, p. 106, No. 298, Pl. 42, Fig. 6, 1889.

Shell thin, opaque, ashy (when living perhaps translucent whitish), oval, smooth, four whorled; spire low, dome-like, not glazed over with callus; suture distinct, not channeled, slightly appressed: surface smooth, marked only by faint incremental lines; body whorl at the aperture thinly glazed but not callous; plaits oblique, distinct, three in number, the posterior weakest, the anterior continuous with the outer lip as it curves around the canal; siphonal fasciole, none; outer lip thin, very slightly reflected at its outer edge and scarcely thickened within, not denticulate; the outer margin of the lip is arched forward and outward; aperture wide, with a shallow anterior sinus and a narrow posterior commissure; maximum longitude of shell 14; maximum latitude 8mm.

Hab.—U. S. Fish Commission Station 2678, in 731 fathoms, ooze, off Cape Fear, North Carolina; bottom temperature 38°.7 F.

This is a remarkably thin, simple, yet elegantly formed species. It is notable, among other things, for having but three plaits, for its absence of callus, and for its perfectly smooth outer lip. I do not recall any species of its own size with which it should be compared. There is a much smaller and probably unnamed species, dredged in deep water in the latitude of Fernandina, Florida, which has a very similar form. The thinness of the shell recalls *M. fauna* Sowerby and *Volvarina pallida*.

All the specimens obtained are of a yellowish ash color, but it is possible that when alive they were more translucent, if not whiter.

Marginella avena Valenciennes.

This species was collected at the Abrolhos Islands, on the Brazilian coast, near Porto Allegre.

Marginella succinea Conrad.

Marginella lactea Kiener.

Persicula catenata Montagu.

The three species above enumerated were obtained at Station 2758, 90 miles southeast from Cape San Roque, Brazil, 419 miles south of the equator, in 20 fathoms, shelly bottom.

Family VOLUTIDÆ.

Genus **SCAPHELLA** Swainson.

Scaphella magellanica Sowerby.

Plate IX, Figs. 5, 6.

Scaphella magellanica Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 452, June, 1889.
Voluta magellanica Sowerby, Thes. Conch., I, 204, Pl. 54, f. 99, 1847; not of Chemnitz, Conch. Cab. X, p. 139, 1788.

HAB.—Straits of Magellan and the eastern coasts of South America north of the Straits to latitude 36° 42′ south; off the Rio de la Plata, in from 10 to 80 fathoms; temperature 42° to 50° F.

In discussing the peculiar nucleus of the shell of *Scaphella* about a year ago, I suggested that the form of the apex indicated the presence in the young larva of a membranous, or at least partly membranous, protoconch to which the normal shell was added and which, after the formation of the normal shell, decayed or was lost. I suggested that the small sharp point characteristic of the tip in certain recent and fossil species of *Scaphella* was probably formed by the deposition of the first shelly matter along the line of the pillar of the membranous larval shell. It was therefore with a great deal of interest that I found in the *Albatross* collection, containing the larval young, several ovicapsules of *Scaphella magellanica* from the coast of Patagonia.

These ovicapsules are circular, about an inch (28^{mm}) in diameter, with a flat base attached to dead Pectens; the upper part consists of a rounded dome, about 12^{mm} high, rather more lenticular than hemispherical, but varying somewhat in different specimens. It is externally exactly like the ovicapsule of *Volutopsis* from Alaska, and, like that, contains two to four surviving larval shells. These remain in the capsule until they have three or four shelly whorls. The apical point is acutely conical, slightly twisted, and in the youngest specimens (two-whorled) still retains some shreds of the extremely fragile mem-

branous protoconch adhering to the first whorl. As suggested by me from a study of the nuclei of *Aurinia*, the pillar of the protoconch and the apical spur of the larval shell coincide. The shape of the protoconch could not be ascertained, but its aperture was probably oval, from its traces left on the shelly surface. The apex is at first very sharp, but it loses substance even in the ovicapsule, and three-whorled specimens had it quite blunted, while shells escaped from the capsule show usually a mammillary tip at all stages. The largest larva obtained, though it had just begun to make part of the shell showing color pattern, was still without cephalic tentacles, eyes, or siphonal appendages. It had no trace of an operculum or epipodium. The shell showed two plaits on the columella. The confirmation of the existence of the suspected protoconch is particularly gratifying. The larval characters emphasize the differences between *Voluta* proper and *Scaphella*, and leave no doubt of the propriety of their generic separation. The turbinate, shelly, peculiarly sculptured larval shell of *Voluta* is entirely different from anything we find in *Scaphella*.

The ovicapsules containing young larvæ were dredged from a depth of about 80 fathoms. The larval shell figured had attained a length of 11^{mm}.

This species, described by Sowerby, is not the *Voluta magellanica*, etc., of Chemnitz, a non binomial author. Chemnitz states in his synonymy that his shell is the *Voluta ancilla* of Solander, in the Catalogue of the Portland Collection; and that he is right is confirmed by his excellent figure, which agree perfectly with Sowerby's figure of *V. ancilla*. Sowerby does not refer to Chemnitz, who, not adopting the Linnean nomenclature, was in no case entitled to priority. The *S. magellanica* is much like the *S. ancilla*, from which it is chiefly distinguished by its smaller size, more slender form, and usually fewer plaits.

Scaphella? brasiliana Solander.

Plate IX, Fig. 2.

The most extraordinary ovicapsule in the *Albatross* collection also belongs to the *Volutidæ*, and after careful study I am disposed to refer it to the species generally known as *Scaphella brasiliana* Solander.

This ovicapsule is oblate-spheroidal in shape, a view from above giving a perfectly circular outline, while from the side the profile is a symmetrical oval. It is yellowish in color but nearly transparent, thin, with a smooth, polished surface like that of wet gelatine, and possesses considerable rigidity. It is sufficiently rigid to retain its form perfectly under considerable pressure, and would probably crush rather than bend to a force too great to be resisted. It was filled with a fluid, probably not very different from sea-water, and contained a single bubble of air, which, by its lightness remaining in the dome of the capsule, just about counterbalanced the weight; so that, without rising to the surface, the capsule would float in the sea at a moderate depth. This

novel craft was freighted with the larval shells of some form belonging to the *Volutidæ*, but in which the calcification appears to proceed equally and simultaneously from the peristome of the protoconch, so that the apex, while indicating that a protoconch had existed, did not present a raised point due to calcification along the columella of that protoconch, as in *Scaphella magellanica*. From careful comparisons, I find the only known species belonging to the region where this ovicapsule was obtained which is not excluded by the character of its nucleus from identification with the larvæ contained therein, is *S. brasiliana*, which has two plaits; and I have little doubt that to that species it should be referred. About twenty-five larval shells were contained in it, each showing two plaits.

This remarkable ovicapsule measures about 55^{mm} in horizontal diameter and 50^{mm} in vertical height. It was collected at U. S. Fish Commission Station 2766, in 10½ fathoms, sand, off the Rio de la Plata, in south latitude 36° 47′ and west longitude 56° 23′. Its specific gravity is almost equal to that of the alcohol in which it is preserved, and consequently it is somewhat lighter than sea-water. Whatever may have been its original condition, the contained air bubble would have made it practically lighter than the water around it, though very slightly so.

According to H. & A. Adams, in the Genera of Recent Mollusca, Orbigny states that "the ovicapsule of *S. brasiliana* is 3 inches in length." As I am unable to refer to Orbigny's work and thus determine how certainly the ovicapsule he refers to was identified with its parent, the question remains doubtful how far it is to be depended upon. It would seem singular to call a circular hemispherical capsule, like that of *Scaphella*, "long," and that adjective would indicate some error of identification. However that may be, if the present ovicapsule, undoubtedly belonging to the *Volutidæ*, does not come from *S. brasiliana*, I am entirely at a loss to conjecture to what mollusk of this region it can be referred.

Genus **VOLUTILITHES** Swainson.

This genus is the Eocene parent of the recent genera of the *Volutidæ*. The *V. abyssicola* Adams & Reeve is not a typical species, but belongs to a small subsidiary group, having a dentate outer lip. The type of *Volutilithes* is the *Voluta spinosa* of Lamarck.

Volutilithes Philippiana sp. nov.

Plate IX, Fig. 4.

Shell (not fully adult) small, elongated, fusiform; color rather dark olivaceous-ash color with a pale band in front of the suture; nucleus superficially eroded, small, apparently not mammillate or inflated when perfect; whorls six, when adult probably with one or two more, appressed at the suture, somewhat constricted in front of it; sculpture of rounded grooves, coarser on the constricted band in front of the suture,

finer and almost linear anteriorly on the last whorl, and slightly coarser again on the canal; the interspaces are flattened, narrow, but always wider than the grooves; there are also some fine, irregularly distributed spiral striæ; transverse sculpture of numerous little elevated, narrow, slightly flexuous waves, which on the penultimate whorl extend from the suture back to the constricted part, where they become obsolete; on the last whorl they are more irregular, fainter, and barely pass the periphery; in a perfectly adult shell they would probably be obsolete on the last whorl; these waves average somewhat less than two millimeters from crest to crest at their most prominent part a little behind the periphery on the earlier whorls; the lines of growth are fine, regular, distinct under a lens and minutely decussate the spirals; aperture narrow, pointed behind, rather wide in front, with no constriction for the canal; outer lip thin, slightly receding near the suture, not lirate within; inner lip slightly excavated, white, with a polished film of glaze over the part from which the limy layer has been absorbed; pillar thin, sharp, nearly straight; canal wide, not differentiated; there is a single prominent, fine, sharp plait just behind the edge of the pillar, and a little further back two smaller subequal plaits closer to each other than the anterior one of the pair is to the larger anterior plait; all are very oblique. Longitude of shell, 36.5; maximum latitude, 14.5; longitude of aperture, 19.5mm.

HAB.—Station 2791, in south latitude 38° 08′, and west longitude 75° 53′, off the southwest coast of Chili, in 677 fathoms, mud; bottom temperature 37°.9 F.

This unique shell belongs to a group of which the other known representatives appear to be extinct. *V. D'Orbignyana*, *V. Domeykoana* and *V. gracilis* Philippi, *V. indurata* Conrad as well as *V. triplicata* Sowerby, all from the tertiary strata of Chili and the western coast of America, are members of it. The *Voluta gracilis* (Philippi, 1887; not of Lea, 1833, or Swainson, 1842) is perhaps its nearest relative, and probably in a large series would prove to be hardly specifically distinct. The name *gracilis* being several times preoccupied, I have therefore applied the name *Philippiana* to the present species, so that if future researches should indicate it to be identical with the tertiary fossil the name will extend to that also. It is intended as a slight compliment to Dr. Philippi, of Santiago, whose labors for nearly three quarters of a century have so much ameliorated malacology.

The west American tertiary group in question may turn out to be, as a whole, equivalent to but one species, in which case *V. triplicata* of Sowerby was first described. But until I have seen specimens of the various named forms, I would lay no stress on this observation suggested by the rather indifferent figures. The present species appears, more nearly than any other recent form, to represent the typical *Volutilithes*, while the *V. abyssicola* is shown by Mr. Watson, from the adult *Challenger* specimens, to be more nearly related to *Lioderma* Conrad.

V. Philippiana and its fossil precursors represent a step in the line of descent from the Cretaceous forms of *Volutidæ* toward *Scaphella* and *Aurinia* as well as *Voluta* proper. *Scaphella* is probably descended from older representatives of the present group, while *Voluta* proper came through the line of forms like *Lyria*, so abundant in the Eocene. It is true that the present species is not spinose at the shoulder like the types of the genus, but even those are frequently smooth, and the Chilian and Oregonian fossils are frequently nodose and almost spiny at the shoulder.

The soft parts of this species were preserved. The exterior of the body is of a yellowish color and, as contracted in alcohol, rather rugose; the foot is moderately pointed behind, in front auriculated at the corners and double-edged; there is no operculum or rudiment of an opercular gland; the head is wide, with rather long, rounded, moderately stout tentacles with an expansion at the outer bases, but no eyes in the specimen before me. The siphon is long and has an appendix near its base on each side of the gutter; the gill and osphradium are as usual; the anus is simple, not free or prominent; near it are a purpuriferous and a large slime-gland, on the dome of the mantle; the verge is small, clavate, with a smaller conical tip, not flattened, about as long as one of the tentacles but thicker. It is situated immediately behind the right tentacle.

The characters of the group as far as can be judged from present data are as follows: Shell transversely ribbed and spirally striated; nucleus minute, not conspicuously differentiated from the immediately succeeding whorls; plaits few, moderate, oblique; animal devoid of an operculum and blind.

Scaphella proper has a membranous larval shell and a styliferous nucleus, and the surface of the adult is usually smooth; *Fulgoraria* has a similar or at least a swollen mammillary nucleus and spirally striated and ribbed whorls with strong plaits.

A careful study of the nuclei in well preserved recent and fossil *Volutidæ* will do much toward elucidating the relations of its subordinate groups. In my report on the Floridian Pliocene, a beginning has been made in this direction. The present species came in very opportunely to assist in determining the characters of the soft parts. An empty ovicapsule dredged with it resembles those of *Scaphella magellanica*, but was only about 10^{mm} in diameter at the base.

Family MITRIDÆ.

Genus **MITRA** Lamarck.

Mitra Bairdii Dall.

Plate XI, Fig. 7.

Mitra (Turris?) Bairdii Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 161, June, 1889.

Shell waxen gray or greenish, elongated, acute, with ten or eleven flattened whorls; nucleus ? (wanting); sculpture consisting on the

earlier whorls of up to fourteen little raised hardly flexuous transverse waves extending clear across the whorls, rounded, equal throughout their length, and separated by shallow slightly wider interspaces; this transverse sculpture becomes gradually fainter, and entirely obsolete on the last whorl, which in the adult seems only marked by the fine and slightly irregular incremental lines which give to the thin, smooth, pale brown, and slightly fibrous epidermis a silky appearance; spiral sculpture of numerous very fine, close, half obsolete grooves or scratches, and six or seven deeper, stronger grooves encircling the canal; whorls mostly flattened, the last slightly rounded; suture distinct, appressed; aperture white, the outer lip thin, sharp, with no liræ in the typical specimen; column with three plaits, the anterior one faint; canal short, nearly as wide as the aperture, hardly recurved; siphonal fasciole distinct; soft parts whitish, with no operculum. Longitude of shell (nuclear whorls lost), 35; of last whorls, 17; of aperture, 12; maximum latitude of shell, 9mm.

Hab.—One living specimen, at Station 2628, 100 miles southeast by south half south from Cape Fear, North Carolina, in 528 fathoms, yellow mud; bottom temperature 38°.7 F.

The soft parts are so contracted that they could not be extracted without breaking the shell. This species looks a good deal like a *Terebra* in form. None of the described species at all resemble it.

Mitra Hanleyi Dohrn.

This species was dredged in 20 fathoms, 90 miles southeast from Cape San Roque, Brazil, at Station 2758.

Subgenus CONOMITRA Conrad.

Conomitra intermedia sp. nov.

Plate v, Fig. 3.

Shell elongated, white, polished, fusiform, with a large smooth shelly nucleus and seven or more whorls; suture distinct, not channeled; whorls with a slight shoulder a short distance in front of the suture, on which are a series of short, narrow, irregularly spaced little-elevated riblets, which, except on the earliest whorls, become almost immediately obsolete; other transverse sculpture only of incremental lines; spiral sculpture of microscopic spiral striæ, often obsolete, and a few fine faint threads on the canal; aperture narrow, elongated; outer lip (broken) thin, not internally lirate; pillar and body with a thin glaze of polished enamel; plaits four, very horizontal, the posterior the highest; pillar straight, attenuated in front; canal short, hardly differentiated from the aperture; maximum altitude of shell, 15.5; maximum latitude, 5.7mm.

Hab.—U. S. Fish Commission Station 2750, off St. Bartholomew, West Indies, in 496 fathoms, sand; bottom temperature 44°.4 F.

This curious little shell very nearly bridges the gap between *Conomitra* and *Mitra*. The large inflated nucleus is a common characteris-

tic of deep water species of many diverse groups; the typical *Conomitra* has a small but also rather bulbous nucleus. It is possible that the whiteness of this shell is due to its dead condition, but it has the unmistakable abyssal facies and is probably colorless in life. Only two dead specimens, one a mere fragment, were obtained.

Family FASCIOLARIIDÆ.

Genus **FASCIOLARIA** Lamarck.

Subgenus MESORHYTIS Meek.

Mesorhytis costatus sp. nov.

Plate v, Fig. 5.

Shell small, thin, slender, the axis slightly bent, of a pale cinereous or buff color, with six or seven whorls; nucleus large for the size of the shell, rather inflated and loosely coiled, polished white; spiral sculpture on the early whorls from four to six little-elevated flattish threads with subequal interspaces; between the suture and the periphery on the later whorls these spirals disappear but persist on the periphery and between it and the succeeding suture or the end of the canal; on the last whorl these threads become faint or obsolete, but on the preceding whorls do not enlarge in crossing the ribs; transverse sculpture on the earlier (except the first two) whorls, of eight to eleven rather stout narrow ribs or costæ, extending from a little in front of the suture over the periphery, where they are strongest, to the next suture, and overrun but not nodulated by the spirals; on the last whorl the transverse as well as the spiral sculpture becomes obsolete; suture distinct, somewhat appressed; whorls moderately rounded; canal slender, slightly tortuous and distinctly recurved; aperture elongate, pointed before and behind, the canal distinct; outer lip thin, simple, not internally lirate; pillar slender, twisted, with a thin glaze; one shorter anterior and two posterior strong transverse plaits. Maximum longitude of shell, 14; maximum latitude of shell, 4mm.

HAB.—U. S. Fish Commission Station 2751, south of St. Kitts, West Indies, in north latitude 16° 54′ and west longitude 63° 12′, in 687 fathoms, globigerina ooze; bottom temperature 39°.9 F.

This species, like *M. Meekii* Dall, was taken without the soft parts. It is a minute fusiform *Fasciolaria* with the transverse plaits of a *Mitra*. In *Ptychatractus*, which seems to be its northern representative, the plaits resemble those of *Fasciolaria* and not those of *Mitra*. The group was first differentiated by Meek as a Cretaceous fossil. Both the recent species inhabit the deep waters of the Antilles. A fragment of still another species, or a *Cordieria*, insufficient for description but evidently new, was dredged in 496 fathoms, at Station 2750, near St. Bartholomew, West Indies.

Genus **LATIRUS** Montfort.

Subgenus LEUCOZONIA Gray.

Leucozonia cingulifera Lamarck.

Leucozonia ocellata Gmelin.

These two species were collected at the Abrolhos Islands, near Porto Allegre, Brazil.

Genus **FUSUS** Lamarck.

Fusus ceramidus Dall.

Plate VI, Fig. 6.

Fusus ceramidus Dall, Bull. Mus. Comp. Zoöl. XVIII, p. 171, June, 1889.

Shell of a waxen or brownish yellow color, of a peculiar waxen subtranslucency, nine-whorled, strongly transversely ribbed, with obscure spiral sculpture, and an imbricated band in front of the suture. Nucleus white, smooth, small but swollen. Transverse sculpture of seven or eight rounded ribs, stouter and more prominent on the early whorls, and on most of them not quite reaching the suture; also sharpish lines of growth which in front of the suture are elevated into flattish, somewhat irregular imbricated scales, forming a narrow band in front of the suture. Spiral sculpture of primary and finer secondary threads, one or two of the former near the periphery becoming sharper and more prominent as they pass over the ribs; on the later whorls all the spiral sculpture has a worn or partially obsolete appearance. Aperture large, canal moderate, curved to the left; outer lip not much thickened, internally lirate; a callous ridge on the body, near the outer lip; the inner lip smooth, or with a few liræ near the canal. Maximum longitude of shell, 46.5; of last whorl, 32; of aperture and canal, 26; maximum latitude of shell, 18.7^{mm}.

HAB.—Near Barbados, in 73 to 103 fathoms, sand; bottom temperature 60° to 71° F.

Fusus æpynotus Dall.

Plate VII, Fig 5.

Fusus æpynotus Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 169, June, 1889.

Shell small, slender, white, eight-whorled; nucleus milk-white, strongly transversely plicate below, above smooth, rounded; spiral sculpture of (on the last whorl eighteen) strong rounded threads of which four or five are visible on the upper whorls; these are slightly swollen, but not keeled, where they pass over the ribs; between these are numerous fine close-set threads slightly marked by inconspicuous lines of growth. The transverse sculpture consists of (on the last whorl ten) rounded, rather close, stout ribs, which pass clear over the whorl and are straight

and slightly larger behind; suture appressed and wavy, conspicuous; canal stout, slightly twisted, aperture subovate, marginated: outer lip internally lirate with two or three strong denticles anteriorly; inner lip smooth, or slightly granulous. Maximum longitude of shell, 24; of last whorl, 16.5; of aperture and canal, 12.5; maximum latitude of shell, 9mm.

HAB.—U. S. Fish Commission Station 2648, off Cape Florida, in 84 fathoms, green mud; also at *Blake* Station 36, in 84 fathoms, Gulf of Mexico; off Sombrero, in 70 fathoms.

This species recalls *F. Bocagei* Fischer, dredged by the *Travailleur* in about 500 fathoms; but that species, from an authentic specimen, is shorter, stouter, with only seven transverse ribs and three principal spiral threads on the spire. The fine spirals in *F. Bocagei* are also more conspicuous. *F. œpynotus* has a little the aspect of *Fusus carolinensis* Verrill, especially the young ones, while differing in many details, especially the number and straightness of the ribs. Its nearest relative would seem to be a form named by Borson *Fusus lamellosus*, from the Tertiary of Modena; but this is merely the young of *F. rostratus*, and the adult has very different characters.

Fusus alcimus Dall.

Plate VII, Fig. 6.

Fusus alcimus Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 170, June, 1889.

Shell resembling *F. œpynotus*, but shorter and more acute at both ends, with only six much more oblique and proportionally stouter ribs, coarser revolving spirals, and none of the fine spiral striation which exists between the primary threads of *F. œpynotus*. It has eight whorls; the nucleus is strongly plicate below; the interspaces between the ribs are deep, and in them the spirals are much closer together than they are on the summit of the ribs; on the last whorl there is sometimes an intercalary single fine spiral thread. The color is yellowish, with touches of dark brown; the canal is very short; the aperture is contracted, the lips much thickened, the outer one strongly internally lirate, the inner one smooth; the suture is inconspicuous and very much waved; maximum longitude of shell, 15; of last whorl, 9.2; of aperture and canal, 7; maximum latitude of shell, 7mm.

HAB.—Gulf of Mexico, in 95 fathoms, 100 miles north of Yucatan.

Fusus alcimus var. Rushii Dall.

Fusus (*alcimus* var.?) *rushii* Dall, *op. cit.*, p. 170, 1889.

Shell smaller, pure white, nucleus hardly plicate, depressions between the ribs less deep, ribs less prominent and hardly oblique. Longitude 8.5; latitude, 4mm.

HAB.—West of North Bemini, Bahamas, in 200 fathoms; Dr. Rush.

FAMILY BUCCINIDÆ.

Genus **BUCCINUM** Linné.

Buccinum viridum sp. nov.

Plate VI, Fig. 9.

Shell delicate, thin, inflated, six-whorled, with a delicate greenish gray, slightly fringed, dehiscent epidermis; spiral sculpture of numerous subequal flattish threads, with narrower rounded interspaces and no intercalary threads; these threads are, as usual, slightly coarser on the base and finer behind the shoulder of the whorl near the suture; at the shoulder a single more prominent but not much larger thread slightly turriculates the spire; whorls full and rounded, especially on the base; suture distinct but not channeled; aperture wide, outer lip somewhat patulous in front, receding toward the suture; canal wide, short, hardly discriminated from the aperture, very slightly recurved; fasciole distinct but not prominent; pillar thin, twisted; inner lip smooth, white, slightly excavated, or the limy outer layer of the shell is there absorbed and the space covered with a thin wash of polished glaze; except for the epidermis the shell is pure white. The outer lip is very thin and but slightly reflected. The nucleus is eroded on the surface so that its character is not determinable. Maximum longitude of shell, 46; of aperture, 24; maximum latitude of shell, 29mm.

HAB.—Station 2839, off Santa Barbara Islands, California, in 414 fathoms, sand.

The operculum is oval, slightly pointed towards the extremities, thin and normal, the nucleus being near the margin about three-eighths of the distance from one end toward the other. The soft parts are whitish, the tentacles moderate, the swelling for the eye present, but usually unpigmented, though a trace of the color seems to remain in some specimens. The gills and osphradium are as usual. The verge is as long as the foot, stout, geniculate, razor-blade shaped, the thin edge being to the right or when recurved and turned under, as is generally the case, to the left; the distal end is squarish, rounded at the corners, the thicker angle terminating with a small acorn-shaped papilla. The dentition recalls that of *B. undatum*, but the central tooth has five sharp, spike-shaped, subequal denticles, the two inner cusps of the laterals, while smaller than the outer cusp, are more nearly its size, the middle one of the three tends to be smaller and to have one or even two minute denticles, one on each side in the latter case, near its base. The formula would be $\frac{1}{3}.\frac{1}{5}.\frac{1}{3}$ and the full formula of a fully developed lateral would be $\frac{1}{1+\frac{1}{3}\cdot 1}$. None of the specimens were fully mature, though the one figured had formed the beginning of the reflected lip, so that its shape could be ascertained; but it is probable that fully mature specimens would have the reflection wider and stronger.

Genus **CHRYSODOMUS** Swainson.

Chrysodomus amiantus sp. nov.

Plate v, Fig. 10.

Shell large, thin, white, with six whorls and a small but prominent inflated subglobular nucleus; spiral sculpture of numerous close-set rounded narrow ridges, of which part are larger than the others; on the early whorls two or three of the primaries are conspicuous on the periphery, with one or two finer ones intercalated; later the peripheral spirals merge with the other primaries, as to size and prominence, and on the last whorl there are four or five intercalary threads between the primaries, the space between the latter, from center to center, averaging 2.5mm to each set; transverse sculpture shows only in fine, slightly irregular lines of growth; the whorls from and including the third are inflated, and the suture, though not channeled, is strongly marked; the canal is short and recurved, the siphonal fasciole indistinct; the aperture is wide, the outer lip, prominent in the middle, receding toward the suture and the canal, smooth not thickened, whitish internally; inner lip concave, with a thin glaze of polished callus, slightly brown tinted; pillar twisted and the axis minutely pervious; the aperture longer than half the shell; operculum brown, moderately stout, apically pointed; maximum longitude of shell, 76; maximum latitude, 43; longitude of aperture, 45mm.

HAB.—Station 2839, near the Santa Barbara Islands, off the coast of California, in 414 fathoms, sand; bottom temperature not taken.

This fine species does not require any comparisons to indicate its distinctness from forms already known. Several specimens of different ages were obtained, all the adults showing more or less strongly the effect of carbonic acid or other eroding agency on the upper whorls, though living when obtained.

The soft parts are whitish externally. The foot double-edged in front, but not auriculate, the tail-end gently rounded; the tentacles, as contracted in alcohol, are subtriangular and somewhat flattened; there is no pigmented organ of vision nor any distinct vestige of such an organ without pigment. The gills and osphradium are as usual; also the female muciparous gland, which furnishes the material for the ovicapsules; the vent projects slightly, but is not free; the penis is not remarkably large, but is geniculate as usual, its front edge thick and rounded, its hinder edge sharp and transversely wrinkled, slightly projecting distally behind a stout, short, conical papilla. The male, as usual, is smaller than the females. The dentition resembles that of *Chrysodomus despectus*, as figured by Friele (Moll. Norske Nordh. Exp., I, Pl. IV, Fig. 9), or even more that of *C. latericeus* (*op. cit.*, Pl. VI, Fig. 16), from which it differs by the outer denticle of the laterals being proportionately a little longer, and the three denticles of the rhachidian being

more slender, close-set, and longer in proportion to the base; the base itself is of a yellow-brown tinge; the laterals and the cusps of the median teeth are of the usual pale-amber color.

I do not remember to have seen attention called to the very general dark color of the "false" or "supplementary gill," or osphradium, as compared with the other soft parts. It is always darker than the true gill; the latter is usually darker than the general surface of the mantle, though not so dark as the substance of the liver.

Chrysodomus griseus sp. nov.

Plate v, Fig. 6.

Shell thin, solid, rather acutely pointed when perfect, but almost invariably eroded at the tip, eight whorled, covered with an olive gray epidermis, the substratum, pillar, throat, and reflected lip milk-white; nucleus eroded, small; suture distinct, not appressed or channeled; whorls full and rounded; transverse sculpture of twenty to twenty-five, narrow somewhat irregular arcuated wave-like ribs, which on the earlier whorls often reach from suture to suture but are strongest on the periphery; some specimens have them faint, others the majority have them strong, but in all they become more or less obsolete on the last whorl; spiral sculpture of rather coarse, rounded, not much elevated cinguli, with narrow interspaces, slightly reticulated by the incremental lines; variable in strength but usually covering the whole surface; in five young specimens the surface over the sculpture is somewhat polished, in adults it has a more rude appearance; aperture oval, wide; the outer lip flexuous as in *Buccinum*, more or less (in some specimens very much) reflected; margin simple, smooth; body polished, the surface slightly excavated and glazed; pillar thin, simple, twisted; the axis widely pervious in the young, minutely or not at all in the adult; canal short, wide, slightly recurved; there is no siphonal fasciole; operculum large, thin, ovoid, slightly curved, with an apical nucleus. Maximum longitude of shell, 32; maximum latitude, 18mm.

Hab.—U. S. Fish Commission Station 2839, near the islands off Santa Barbara, California, in 414 fathoms, grey sand; temperature not recorded.

Animal whitish, with a little gray about the head and tentacles. General form and details as in *C. amiantus*, except that the tentacles are longer and more cylindrical and the verge is proportionately larger, more cylindrical, with the termination swollen, slightly hood-shaped, with a granular depressed oval area set obliquely at one side and no visible terminal papilla. I am uncertain how much of the difference noted in this organ between different species is due to its different degrees of extension when placed in alcohol and differences in contraction taking place under the influence of alcohol.

The dentition agrees with that of *C. amiantus*, but is of course on a much smaller scale. The sexual differences in *C. griseus* are less than

in the previous species, the females being generally somewhat more robust and having the concave wave in the outer lip somewhat more pronounced. The operculum of the extremely young is buccinoid, but this character is lost very early. Perhaps this may be found to be the case throughout the genus.

Chrysodomus aphelus sp. nov.

Plate VI, Fig. 7.

Shell small, buccciniform, six whorled, smooth, covered with a greenish-gray epidermis; nucleus minute, eroded; whorls full, well rounded; suture distinct, not deep nor channeled; sculpture only of faint incremental lines and a few obscure spiral traces; aperture moderate, the outer lip thin, very slightly reflected, flexuous; body and pillar lips white, polished, without callus; pillar short, strong, curved, obliquely truncate anteriorly, well recurved; canal short, wide, well defined, and recurved; throat smooth, white; axis not pervious; operculum normal. Maximum longitude of shell, 30; maximum latitude, 15mm.

HAB.—Station 2839, in 414 fathoms, off the coast of Santa Barbara county, California.

The soft parts of this species agree with those of the preceding, *C. griseus*, except that in the sole male specimen a blunt papilla protrudes from the oval depressed area at the end of the verge, and a little more than one-fourth the way from the external bases of the tentacles toward their tips are situated eyes of unusual size and blackness. The dentition does not differ from that of *C. griseus*. Here we have the interesting fact of two species of the same group, nearly related, from the same identical spot in the archibenthal region of the Pacific, in one of which the environment has induced blindness, while in the other the eyes have been retained and become larger, and in all probability more sensitive. This seems to me to indicate the existence of a certain amount of light on the sea bottom at over 400 fathoms.

This modest little shell presents few salient characters, but its very simplicity is notable and attractive. With the preceding species it belongs to a peculiarly buccciniform group, which are characterized by a strongly reflected lip, short canal, and minute nucleus in the shell, but which, so far as the soft parts are concerned, present no obvious points of difference having systematic value from the larger and, so far as the shell is concerned, more normal species from shallow water.

Subgenus SIPHO Mörch.

Chrysodomus (Sipho) Rushii Dall.

Plate V, Fig. 1.

Chrysodomus (Sipho) Rushii Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 175, June, 1889.

Shell small, thin, white, elongated, with a furfuresceut epidermis and six whorls. Nucleus regular, white, smooth, but becoming gradually

spirally striate; whorls well rounded; suture distinct; spiral sculpture of (between the sutures five) primary threads, with a smaller thread in the intervals and finer ones on the anterior part of the last whorl and canal; these are crossed by fine flexuous lines of growth which decussate the threads, or give them, in strongly sculptured specimens, a somewhat beaded look; there are also twelve to fifteen faint flexuous ribs crossing the whorl, tending to become obsolete on the last half of the last whorl, and more marked on some specimens than on others; these are quite concave at and behind the periphery; canal short, narrow, twisted to the left; columella rather concave; aperture entirely simple, with no visible callus; operculum rather wide and short. Maximum longitude of shell, 11; of last whorl, 7.5; of aperture and canal, 5.5; maximum latitude of shell, 4.5; of aperture, 1.25mm.

Hab.—Station 2644, off Cape Florida, in 193 fathoms, sand; bottom temperature 43°.4 F.; Station 2668, off Fernandina, in 294 fathoms; also in 205 fathoms, off Fowey Rocks, in the Straits of Florida; by Dr. W. H. Rush, U. S. Navy.

This is a delicate and pretty little shell, which is, in its general characters, very much like the young state of *Tritonidea limbata* Philippi (+ *Fusus pulchellus* Pfr. non Phil.); but that is more strongly sculptured and has a different nucleus, beside being clouded with color.

Chrysodomus (Sipho) testudinis sp. nov.

Shell short, stout, white, with five or more whorls; apex eroded; the last two whorls show about fifteen short, stout, transverse ribs, which do not reach the suture and become obsolete a little in front of the periphery; they are most prominent at the shoulder of the whorl; behind them there is a moderate constriction and the whorl is strongly appressed in front of the suture; beside the ribs, the transverse sculpture consists of irregular, strong, incremental lines; spiral sculpture of numerous coarse, close-set, rounded threads, mostly alternating larger and smaller or more and less prominent near the suture; these are a little granulated by the incremental lines; there is a thin, pale yellow, hispid epidermis; aperture elongate, outer lip slightly thickened with a band of livid pink just inside the sharp simple margin; body and pillar with a solid, also slightly pinkish, callus; pillar a little tortuous, attenuated in front; canal rather short and wide, somewhat recurved, not well differentiated from the rest of the aperture. Maximum longitude of (decollate) shell, 30; of last whorl, 22.5; of aperture, 18; diameter, 15mm.

Hab.—Station 2807, in 812 fathoms, ooze, near the Galapagos Islands, Pacific Ocean; temperature 38°.4 F.

This is a very strongly marked species, but the specimens were greatly eroded and none showed the nuclear whorls or the sculpture on the canal or near the apex.

It has the presutural channel of some of the pleurotomoid forms, but there is no notch or fasciole. The soft parts are as usual; the animal possessed small pigmented eyes and the operculum offered no peculiarities. I do not know any species which greatly resembles it.

Genus **PISANIA** Bivona.

Pisania pusio Linné.

This species was abundantly collected at the Abrolhos Islands, Brazil.

Genus **ENGINA** Gray.

Engina turbinella Kiener.

Collected at the Abrolhos Islands.

Genus **NASSARIA** Link.

Subgenus NASSARINA Dall.

Nassarina columbellata Dall.

Plate VI, Fig. 8.

Nassarina columbellata Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 182, June, 1889.

Shell pure white, attenuated anteriorly, rather acutely conical behind, with eight whorls. Nucleus two-whorled, polished, smooth, milk-white, rather large; spire flatly conical, with a conspicuous suture; upper whorls with about five strong, close-set, equal threads, most conspicuous in the interspaces between the numerous (on the last whorl eighteen) flattened transverse ribs, which cross the whorls but stop short before the sutures, giving a grooved aspect to the latter, which is increased by the existence of a peripheral line or space, wider than any of the others, between the two spirals nearest the periphery; last whorl attenuated toward the long canal, but not constricted, as in *N. Bushii* Dall; aperture long, narrow, contracted, with an elevated continuous margin, interrupted only by the canal, which is recurved near its termination; outer lip with four or five internal teeth; inner lip with five or six finer, smaller ones; whorls not rounded above. Maximum longitude of shell, 12.2; of last whorl, 8; of aperture, 6; maximum latitude of shell, 4.5^{mm}.

HAB.—U. S. Fish Commission Station 2367, off Cape Catoche, Yucatan, in 124 fathoms, sand.

The upper whorls of this shell are flattened and sculptured much like those of *Columbella similis* or *translirata*. The species of this group seem to bear much the same sort of a relation to *Nassaria* proper as *Strombina* does to the typical *Columbella*.

Family NASSIDÆ.

Genus NASSA Lamarck.

Nassa scissurata Dall.

Plate v, Fig. 2.

Nassa scissurata Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 185, 1889.

Shell short, conical, glistening, white, clouded with light brown or buff; whorls stout, well rounded; nucleus of two translucent turns, smooth, or transversely slightly wrinkled; remainder, comprising five or six turns, separated by a deep but not channeled suture; sculpture of (on the last whorl about fourteen) stout, rounded ribs, with wider interspaces, completely crossing the whorls, and fine incremental striæ; spiral sculpture of (on the last whorl about ten) revolving ridges, faint in the interspaces, strongly ovally noduled on the ribs, three rows showing on the upper whorls; ribs interlocking at the sutures; aperture rounded, with its edge continuous and raised, contracted in front of a stout varix, lirate on both sides; a stout tooth on the body and another at the base of the pillar; a deep groove behind the siphonal fasciole; canal short, strongly twisted; operculum serrate at the sides. Longitude of shell, 12; of last whorl, 8; of aperture, 5; maximum latitude of shell, 7.5mm.

Hab.—The Antilles and Gulf of Mexico, in 76 to 805 fathoms, rocky bottom; bottom temperature 58°.5 to 65° F.

This species is clearly distinguished from *N. Hotessieri*, which is its nearest relative, by the character of the sutures, which are not channeled, by its fewer strongly nodulated ribs, and by the curve of the ribs, which in *Hotessieri*, as in most ribbed univalves, are convex forward on the periphery, and then curve a little backward, while in *N. scissurata* the curve is in a contrary sense, as is at once evident on comparing two specimens. The total curve is not great, but quite sufficient to form a marked distinction.

This species has the bright waxen luster of a deep-water shell, and probably lives in between 75 and 200 fathoms depth. Its sculpture recalls that of *N. spinulosa* Phil.

Nassa Townsendi sp. nov.

Plate XII, Fig. 9.

Shell small, short, very stout, yellowish white, with six whorls; nucleus eroded; transverse sculpture of about sixteen narrow, rounded, low riblets, which extend from suture to suture, but on the last whorl fade away in front of the periphery; the interspaces are nearly twice as wide as the ribs, which in front of the suture have two or three small, prominent nodules coronating the whorls, caused by the intersection of as many spiral threads, which, however, are faint or obsolete in the

interspaces; incremental lines not prominent; spiral sculpture of (in addition to the presutural threads above mentioned) numerous rather faint threads on the base of the last whorl and on the canal; surface somewhat polished with a very thin epidermis; aperture short, wide, with a thin, simple outer lip, perhaps thickened later; no internal lirae; inner lip with a smooth, moderately thick, white callus; canal very short and slightly recurved; edge of the pillar raised and sharp. Maximum longitude of shell (without nuclear whorls), 10; diameter, 6mm.

HAB.—Station 2807, near the Galapagos Islands, in 812 fathoms, ooze; temperature 38°.4 F.

This species is nearest to *N. babylonica* Watson, from near the Philippine Islands, and like that has a chrysodomoid operculum. It is, however, stouter, with a proportionately shorter spire, compared with the last whorl, and is more inflated. The operculum is also more elongated.

This species is named in honor of Mr. C. H. Townsend, of the U. S. Fish Commission, one of the naturalists connected with the *Albatross* in her later explorations.

Family COLUMBELLIDÆ.

Genus **COLUMBELLA** Lamarck.

Section ASTYRIS H. & A. Adams.

Columbella permodesta sp. nov.

Plate v, Fig. 4.

Shell small, thin, polished, with five rounded whorls, a pale yellowish epidermis covering a bluish white substratum; transverse sculpture only of faint incremental lines; spiral sculpture of fine spiral threads on the base of the shell, obsolete or absent between the sutures; aperture wide, oval; outer lip thin, simple, very slightly reflected; axis pervious; canal wide, extremely short, hardly differentiated; pillar smooth, twisted, not callous; suture distinct, not appressed or channeled; nucleus rounded, slightly flattened, generally eroded. Maximum longitude of shell, 14; maximum latitude, 7mm.

HAB.—Station 2840, off the Santa Barbara Islands, California, in 276 fathoms, mud.

The soft parts of this animal are of a greenish white color. The foot is unusually long, narrow, pointed behind, double-edged, truncate, and distinctly auriculate in front. The tentacles are very short, stout, blunt, and stand straight forward with a notch between them rather than laterally from the head; the basal part is swollen outwardly and there are pigmented eyes, but so hidden beneath the cuticle as to be readily overlooked when the latter is rendered opaque by alcohol. The sides of the foot are smooth, they are marginated below as in *Limax*, so that the sole is distinctly marked off from the upper surface. The whole animal exudes an abundant mucus. The proboscis is stout, its opening notched below. The gills are rather large, but otherwise

as usual. The osphradium also presents nothing unusual. The verge is extremely long, slender, nearly cylindrical, situated on the right side a little distance behind the right tentacle; as contracted in alcohol it was about 7mm in length, tapering gently to a subconical point, without papillæ or appendages of any sort. The dentition resembles that of *C. Hölbollii* as figured by Lovèn, and the species evidently belongs to the same section of the genus, though with a more buccinoid shell than any of the others. The median tooth is a wide, flat, arcuate, edentulous plate without anything resembling a cusp. The laterals have the usual form and two rather rounded denticles near the tip.

The operculum recalls that of *Nassa*, but is rounded at the corners with an entire edge, the nucleus within the margin at the smaller end and a lunate ridge of yellowish translucent callus bounding the scar internally.

A large number of specimens of this species were taken, living at the locality indicated. All were more or less eroded at the tip and were incrusted with a scaly combination of calcareous matter and iron of a rusty color.

Section COLUMBELLA s. s.

Columbella mercatoria Lamarck.

Collected at the Abrolhos Islands.

Section ANACHIS Adams.

Columbella Saintpairiana Caillet.

Collected at Station 2765, off the Rio de la Plata, in 10½ fathoms, sand.

Columbella Verrillii Dall.

C. (*Astyris?*) *Verrillii* Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 192, Pl. XIX, Fig. 8.

Collected at Station 2756, in 391 fathoms, sand, off the Para River, Brazil.

Section NITIDELLA Swainson.

Columbella moleculina Duclos.

Collected at Stations 2764 and 2765, off the Rio de la Plata, in 10½ fathoms, sand.

Subgenus AESOPUS Gould.

Aesopus Metcalfei (Reeve) Dall.

Aesopus Metcalfei Dall, *op. cit.*, XVIII, p. 194, 1889.
Terebra Metcalfei Reeve.

Collected at Station 2764, off the Rio de la Plata, in 10½ fathoms, sand. It was previously known from Santo Domingo.

Family MURICIDÆ.

Subfamily MURICINÆ.

Genus **MUREX** Linné.

Murex (Chicoreus) Leeanus sp. nov.

Plate VII, Fig. 1.

Shell strong, stout, pale yellowish brown, with three varices to each whorl, and a faint intervarical node between each pair of varices; the varices toward the apex fall slightly short of completing a whole whorl, so that they are slightly spirally arranged; the deficit on the whole shell of six and a half whorls (excluding the nucleus) is about one-quarter of a turn, so that the great varical spines on the spire are not directly over one another; nucleus minute (lost in the specimen); first whorl or two with eight or ten small spiny or scaly nodes; at the third whorl the spines begin to take on the characteristic trialate arrangement; spiral sculpture of rather fine, rounded threads, almost uniformly distributed, slightly coarser in front of the periphery and on the varices, and in front of the suture for a short distance nearly obsolete; the interspaces are narrow grooves, with very rarely an intercalary thread; there are also fine microscopic spiral striæ; this spiral sculpture, with the qualifications noted, covers the whole shell; transverse sculpture of intervarical nodes obsolete or obscure on the last whorl, growing stronger and sharper toward the apex; apart from the varices the only other sculpture, in a transverse sense, is due to irregularities of growth or faint incremental lines; the varices on the last whorl are slightly elevated, rounded ridges, extending from the suture to the end of the canal; behind the periphery the whorl is flattened; at the periphery or shoulder of the whorl each varix is extended in a strong, stout, single hollow spine, rounded behind, deeply narrowly grooved in front, curving slightly upward and more strongly backward toward its distal end; the aperture is ovate, rounded behind, a little pointed in front, with a thin, raised edge, white or waxen internally and without denticulations; the canal is closed, long, stout, obliquely truncate in front, showing two older termini at the left beside the one in actual use. Maximum longitude of shell, 70; maximum latitude, including spines, 63; latitude of aperture, 13.5; longitude of aperture, 20mm.

HAB.—Station 2838, off Cerros Island, Lower California, in 44 fathoms, mud.

The only species with which this fine *Murex* need be compared is *M. centrifugus* Hinds, a member of the same faunal region, which also was collected near Cape St. Lucas, in 12 to 51 fathoms. The specimens of *M. centrifugus* hitherto collected have not exceeded 35mm in total length. The most obvious difference between the young of *M. Leeanus* and *M. centrifugus* of the same size is seen in the varical processes. In *M. Leeanus* a section of these processes at any age is oval, with a

deep groove on the anterior side which is widest internally, since the lips of the groove fold over one another in most cases, so that the processes contain a permanent subtubular gutter. In *M. centrifugus* the varical spines are triangular in section, the anterior margins do not approach one another, and a shallow median sulcus on the front of the spine is the only representative of the groove of *M. Leeanus*. Below the main spine on each varix in *M. centrifugus* are three smaller flat spines; on *M. Leeanus* the varix is rounded and without spines. The intervarical node in *M. Leeanus* is obsolete or obscure and rounded; in *M. centrifugus* it is much more prominent in proportion and forms an oblique rather narrow rib with a kind of elbow at the periphery. The most prominent character of *M. Leeanus* is the rounded, root-like, sleek varical spine.

It is named in honor of Prof. Leslie A. Lee, of Bowdoin College, in charge of the scientific work of the *Albatross* party during the voyage.

The specimen was a female. The foot is auriculate and double edged in front, short, rounded behind, with nearly smooth sides. The eyes are small, the basal two-thirds of the tentacles behind the eyes is stout and thick, the distal part beyond the eyes much more slender.

The dentition is typically muricoid, the radula small and narrow, the central tooth very wide, very short, and with three inconspicuous denticles on its cusp. The soft parts hardly differ externally from those of *Murex brandaris* L.

Subgenus PTERONOTUS Swainson.

Pteronotus phaneus Dall.

Plate xi, Fig. 1.

Pteronotus phaneus Dall, Bull. Mus. Comp Zoöl., xviii, p. 201, June, 1889.

Shell ashy white, elongated, thin, six-whorled. Nucleus translucent, smooth, polished, of about one and a half whorls; whorls slightly convex, appressed to the suture behind them, connected by three continuous fin-like varices which in descending the spire make about half a revolution around it; these varices on the upper whorls were extended backward into a little wing-like point with dentate edges; on the last whorl the lines of growth indicate that the thin margin was rounded parallel with the whorl. Transverse sculpture of fine growth lines, and on the last two whorls at the periphery three short little narrow pinched-up riblets between the varices; spiral sculpture of fine rather faint striæ and wider undulations, hardly visible except on the varices; of these there are nine or ten on the last varix. Aperture elongate-oval, internally white, thickened, smooth; canal rather long, open, bent back. Maximum longitude of shell, 17; of last whorl, 13.5; of aperture, 5; maximum latitude of aperture, 3; of shell, 8mm.

Hab.—U. S. Fish Commission Station 2662, off St. Augustine, Florida, in 434 fathoms, sand; temperature 43°.7 F.; also at Station 2668, in 294 fathoms.

This species agrees more nearly with the Indo-Pacific species by having three intervarical ribs, while the Atlantic species hitherto known have only one. It is, however, more nearly related to *P. tristichus* Dall than to any hitherto described, as far as I have been able to ascertain. The body of the shell is not unlike that of *P. cordismei* Watson, figured in the *Challenger* report, but the present species has none of the semitubular spines which give the Australian shell the look of a *Typhis*. A variety almost wants the intervarical ribs and has the fin-like point of the varices present on all of them. It is probable that there is a good deal of variation in these small details.

Genus **EUPLEURA** H. & A. Adams.

Eupleura Stimpsoni Dall.

Plate XI, Fig. 3.

Eupleura Stimpsoni Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 204, June, 1889.

Shell small, thin, whitish, not polished, with four varices to the whorl and five whorls; nucleus smooth, white; spiral sculpture of extremely fine-faint striæ and of (on the last whorl) five low keels, most prominent on the back of the varices. The posterior keel is produced at the shoulder as a spine, which on the front side of the varix looks as if it were holding up the webbing of the varix as a tent-pole holds a tent; the other keels are represented on the front of the varix only by shallow grooves. The transverse sculpture is composed of well-marked incremental lines; above the spine on the last whorl the web of the varix extends to the fifth preceding varix; below the spine it follows the outline of the aperture nearly, and terminates midway down the canal; the margin is even except at the spine and the ends of the grooves; aperture rounded, continuously marginate except at the open narrow canal; there are four teeth inside the outer lip in front of the spine, and three near the front of the inner lip; the canal is slightly recurved, the end of the antecedent canal projecting from it at the left; suture well marked. Maximum longitude of shell, 12; of last whorl, 9; of aperture, 3; of canal, 4; maximum latitude of aperture, 2.2; of the varix at the spine, 2.8; of the shell, 7mm.

HAB.—Near Barbados, in about 100 fathoms; dredged alive, but the soft parts were lost before the specimens were received.

Subfamily **PURPURINÆ**.

Genus **PURPURA** Bruguière.

Purpura deltoidea Gmelin.

Purpura hæmastoma L. var. **trinidadensis** Guppy.

The above were collected at the Abrolhos Islands, on the southeast coast of Brazil.

Subfamily CORALLIOPHILINÆ.

Genus **CORALLIOPHILA** Adams.

Coralliophila abbreviata Lamarck.

Collected at the Abrolhos Islands. It is frequently called *C. galea* Chemnitz, but that author did not use the Linnean nomenclature.

Suborder STREPTODONTA.

Superfamily PTENOGLOSSA.

Family SCALIDÆ.

Genus **SCALA** (Humphrey) Auct.

Section ACRILLA A. Adams.

Scala pompholyx sp. nov.

Shell thin, conical, inflated, white, with a pale yellow epidermis, smooth, polished, glassy nucleus, and nine or more whorls; spiral sculpture of fine numerous close-set rounded threads, with narrower interspaces, covering the whole surface, and a single stouter thread marginating the base, on which the suture runs; transverse sculpture of rather irregular rounded wrinkles following the incremental lines when present, but often absent, to some extent reticulating the stronger spirals; also of extremely thin, hardly raised, varical lamellæ, about 32 on the last whorl; these are a little more elevated in the vicinity of the suture and a little fainter on the base; suture distinct, not deep; base imperforate; aperture subcircular, a little angulated below. Maximum longitude of shell, 14; of last whorl, 8; maximum diameter, 7.6mm.

HAB.—Station 2807, near Galapagos Islands, in 812 fathoms, ooze; temperature, 38°.4 F.

This species is remarkable for its faint reticulated sculpture, its thin and inflated whorls, and its rapid increase in diameter. I do not find any closely related species to compare it with.

Scala babylonia Dall.

Plate XI, Fig. 8.

Scala babylonia Dall, *op. cit.*, p. 311, June, 1889.

Shell thin, white, elongate, with fifteen rounded whorls (nucleus lost), each ornamented with about twenty-five thin sharp varices, each of which has a small triangular sharp point half-way from the suture to the periphery; behind these the interspaces are smooth to the suture; in front of the varical points the surface is sculptured with raised flat-topped threads with wider intervals between them and numerous still finer spiral striæ; the spiral sculpture does not crenulate the varices; shell imperforate, without basal disk or cordon; aperture small; lip thin, narrow, hardly reflected, tortuous, and a little patulous at the anterior

end of the axis; suture very deep. Longitude, 30; maximum latitude, 6.5mm.

HAB.—Station 2678, off Cape Fear, in 731 fathoms, light gray ooze; bottom temperature, 38°.7 F.

The specimen procured was fresh, but without the soft parts. This beautiful species somewhat resembles Verrill's figure of *S. Dalliana*, but is longer, much more cylindrical, and has strong spiral sculpture which is wanting in that species. The upper fourth of *S. babylonia*, which would about correspond in size to *S. Dalliana*, has the costæ more sparse, thin and erect, the whorls much rounder, and the suture much deeper than in that species. None of the other species described from deep water are much like it.

Scala denticulata Sowerby.

Collected at Station 2762, east from Rio Janeiro, in 59 fathoms, mud.

Genus **ACLIS** Lovén.

Aclis nucleata Dall.

Aclis nucleata Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 325, Pl. XVIII, Fig. 7, June, 1889.

First collected by the *Blake* at St. Vincent, West Indies; then by the U. S. Fish Commission, in 294 fathoms, off Fernandina, Florida. The *Albatross* still further extends the list of localities by adding Station 2750, off the island of St. Bartholomew, in 496 fathoms, sand; temperature 44°.4 F.

This last specimen is the finest yet found, and measures 17mm long by 4.8mm in maximum diameter.

Genus **PERISTICHIA** Dall.

Peristichia Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 339, 1889.

Shell elongated, acute, many-whorled, dextral, with a small, sinistral nucleus, spirally or reticulately sculptured; aperture ovate, lips thickened; columella straight, simple, without plaits, a basal cord entering the aperture on the body between the pillar and the outer lip; aperture anteriorly a little effuse, but not channeled in front of the pillar; outer lip varicoid in the adult, internally with a few very strong liræ; soft parts?

Type, *Peristichia toreta* Dall.

This genus has the spire, sculpture, and nucleus of *Mathilda;* the basal cord is like that of *Oscilla nivea;* the outer lip, though less patulous and more varicose, has something about it which recalls *Rissoina*. It is like an *Oscilla* without columellar plaits, or like a *Mathilda* with a thickened and internally lirate peritreme and rounded base. As far as one may judge from the characters of the shell alone, this genus would indicate the passage between *Mathilda* and *Oscilla*.

Peristichia toreta Dall.

Plate xi, Fig. 10.

Peristichia toreta Dall, Bull. Mus. Comp. Zoöl., xviii, p. 340, June, 1889.

Shell slender, yellowish white, thirteen-whorled; nucleus minute, glassy, set on edge, having about two turbinate whorls; spire with the suture distinct, marked by a plain or slightly undulate thread behind it; behind this is a strong nodulated spiral, with round nodules, then a little interval and two more, slightly smaller, similar nodulous spirals, adjacent to each other and to the suture behind them; the last whorl would show about thirty-four nodules in its circuit; transverse sculpture of elevated ridges, visible in the interspaces following the line of the nodules across the whorl; on the rounded base they appear as strong radii; base with one strong cord, with a deep sulcus outside of it, and the space between it and the pillar somewhat excavated; aperture ovate; pillar straight, forming almost a right-angle with the lip in front of it; outer lip with three strong internal liræ; body with the basal cord projecting, slightly covered with enamel; outer lip swollen, varicose, and whiter than the rest of the shell, its margin undulated by the external sculpture; callus joining the pillar and outer lips distinct and continuous. Maximum longitude of shell, 10.75; of last whorl, 3; maximum latitude of shell, 3mm.

Hab.—Coast of North Carolina, at U. S. Fish Commission Stations 2607, 2608, in 18 to 22 fathoms, sand, 16 miles off Cape Lookout; bottom temperature 73° to 78° F. Charlotte Harbor, West Florida, in 2 fathoms, weedy bottom; Dall. Key West, between tides; H. Hemphill.

This is an extremely elegant shell, in which the relative strength of the transverse and the spiral sculpture varies somewhat in different individuals. The sides of the spire are straight, but the whorls are distinctly marked.

The color in very fresh specimens is a milky white, more or less clouded with pale yellowish brown on the base or sides.

Superfamily TÆNIOGLOSSA.

Family TRITONIIDÆ.

Genus **TRITONIUM** Link.

Subgenus RANULARIA Schumacher.

Ranularia tuberosa Lamarck.

Collected off the Rio de la Plata, in 10½ fathoms, sandy bottom.

Family OÖCORITIDÆ.

Genus **OÖCORYS** Fischer.

Oöcorys sulcata Fischer.

Oöcorys sulcata Dall, Bull. Mus. Comp. Zoöl., xviii, p. 228, 1889.

Collected at Station 2751, south of St. Kitt's, West Indies, in 687 fathoms, ooze; temperature, 39°.9 F.

Family TRIFORIDÆ.

Genus **TRIFORIS** Deshayes.

Section MASTONIA Hinds.

Triforis pulchella C. B. Adams.

Collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, shelly bottom.

Family CERITHIIDÆ.

Genus **CERITHIUM** Bruguière.

Cerithium semiferrugineum Lamarck.

This species, which ranges throughout the Antilles and as far north as St. Augustine, Florida, was collected at Port Castries, Santa Lucia, and at Station 2758, off the Brazilian coast, in 20 fathoms.

Family SEGUENZIIDÆ.

Genus **SEGUENZIA** Jeffreys.

Seguenzia monocingulata Seguenza.

Collected at Stations 2751, 2756, and 2760, in 391 to 1,019 fathoms, mud and ooze; temperatures 37°.9 to 40°.4 F. The southernmost station is 90 miles north from Ceara, Brazil, in south latitude 12° 67′ and west longitude 37° 17′.

Seguenzia trispinosa Watson.

Collected at Station 2754, in 880 fathoms, ooze, east from Tobago, and at Stations 2751 and 2760, with the preceding species.

Family VERMETIDÆ.

Genus **VERMETUS** Mörch.

Subgenus PETALOCONCHUS Lea.

Petaloconchus irregularis Orbigny.

Abundant at the Abrolhos Islands, Brazil.

Family LITORINIDÆ.

Genus **LITORINA** Férussac.

Section MELARAPHE Muhlfeldt.

Litorina angulifera Lamarck.

Abundant and large, and rather pale colored, at the Abrolhos Islands. Of the two series of color markings those connected with the spiral striæ were the least conspicuous.

Family LITIOPIDÆ.

Genus **ALABA** A. Adams.

Alaba conoidea Dall.

Alaba conoidea Dall, List of Marine Mollusks, etc., Bull. U. S. Nat. Mus., No. 37, p. 146, 1889.

Shell small, conical, subtranslucent white, with six whorls; apex rather blunt; nucleus not differentiated; whorls polished, sculptured only with obscure incremental lines, suture distinct, a little channeled; sides of the spire flattened, the whorls hardly rounded; the base almost carinate or bluntly rounded; aperture lozenge shaped, angulated at the end of the carina, pointed bluntly in front and behind; body and pillar somewhat callous; operculum normal; the shell has but one or two not very conspicuous varices, all on the last whorl. Maximum longitude 3.3; diameter 1.6mm.

Hab.—Station 2595 and 2596, off Cape Hatteras, North Carolina, in 49 to 63 fathoms, sand; Station 2612, in 52 fathoms, sand, off Cape Lookout, North Carolina; and Station 2668, in 294 fathoms, gravel, off Fernandina, Florida; and by Dr. W. H. Rush, of U. S. S. *Blake*, on the Campeche Bank, in 200 fathoms; temperatures 46° to 75° F.

Family SOLARIIDÆ

Genus **SOLARIUM** Lamarck.

Solarium bisulcatum Orbigny.

Collected at Station 2762, east from Rio Janeiro, in 59 fathoms, mud. It extends northward to the archibenthal area off Martha's Vineyard, where the young was described by Professor Verrill under the name of *S. boreale*.

Family RISSOIDÆ.

Genus **BENTHONELLA** Dall.

Hela Jeffreys, 1870 (*ex parte*) not of Münster, 1830.
Benthonella Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 281, June, 1889.

In the fifth volume of his British Conchology (p. 204, pl. 101, f. 7, 1869), Dr. Jeffreys described a *Lacuna tenella* dredged by Drs. Carpenter and Thomson, in the North Atlantic, at a depth of 180 to 650 fathoms. The types are in the Jeffreys' collection now in the U. S. National Museum. In July, 1870, in the "Annals and Magazine of Natural History," he proposed a genus *Hela* for these shells, which he still retained in the vicinity of *Lacuna*. The name *Hela*, however, had been preoccupied in Crustacea for many years. In the proceedings of the Zoological Society for 1883 (p. 110), he referred his genus to *Cithna*, a subgenus of *Fossarus*, proposed by Arthur Adams (P. Z. S., 1863, p. 110). An examination of three species of *Cithna*, sent by Mr. Adams to Dr. Jeffreys,

convinces me that *Cithna* Adams, is not a member of the family *Lacunidæ* nor allied to *Fossarus*, neither is the Japanese genus the same as the *Hela* of Jeffreys. Indeed, *Cithna* Adams, with its small pointed apex and continuous peritreme does not offer any very good characters which might separate it from *Cingula* or *Littorinella*. Owing to the fact that several of Dr. Jeffreys' species of *Hela* or *Cithna* are probably *Vitrinellæ*, I did not at first recognize that the shells which I called *Benthonella* were of the same genus as those first named *Hela*, by Jeffreys. After the Blake Report was in type it suddenly occurred to me that it was remarkable that *Hela* did not appear in the dredgings of the Fish Commission, or the *Blake*. A re-examination of Dr. Jeffreys' material revealed the fact that his original type, and also the *Cithna margaritifera* of Watson should be referred to *Benthonella*. This genus I regard as a thin-shelled deepwater member of the *Rissoidæ*, with a blunt apex, turbinate brownish nuclear shell and a thin paucispiral operculum. The umbilicus is always small, bounded by a more or less evident ridge or angle at the base, the shell is always thin and polished, the aperture simple and sharp-edged, the peritreme interrupted by the body whorl, and the pillar lip arcuated or passing insensibly into the rounded base. The operculum is like that of *Lithoglyphus*, as figured by H. & A. Adams, thin, translucent horn color, without any process internally. The epidermis, if any exists, is so thin and close as to seem absent. The species which may be referred to *Benthonella* are, *B. tenella* (Jeffreys), *B. margaritifera* (Watson), *B. gaza*, *B. Fischeri*, and *B. nisonis* Dall. A shell named *tenella*, by Jeffreys, from the Zanclean formation of Calabria, is not *Hela tenella* Jeffreys, but is possibly a *Benthonella*. The only specimen in the Jeffreys collection is somewhat abnormal. A specimen marked *Hela inflata* Monterosato, seems to be a *Vitrinella;* it was dredged by Nares, in the Mediterranean, in 200 fathoms. *H. fulva* Jeffreys, from Korea (St. John), is not a *Benthonella*. *Cithna Adamsi*, *cincta*, *carinata*, and *naticiformis* of Jeffreys (P. Z. S., 1883, pp. 111–112, pl. xx) do not belong to *Benthonella* nor to the original *Cithna* of Adams. They resemble *Vitrinella* as much as anything else.

A careful scrutiny of the specimens in the Jeffreys collection shows that *B. tenella* was collected by the *Porcupine* in 1869 at stations 4, 23, 23*a*, 36, 39, 40, and 41; in 1870 at stations 16, 17, 51, 54, and 55. It was also dredged in the Mediterranean by Spratt and Nares in 96 to 600 fathoms. *B. margaritifera* (which is very like *B. Fischeri*, but ribbed transversely) was obtained by the *Porcupine* in 1870 at stations 16, 17, 17*a*, and 22; also in Setubal Bay and off Cape Espichel.

The three West Atlantic forms seem uniformly larger than those from the Mediterranean and Eastern Atlantic. All the species are closely related and differ in details of form, size, and proportion rather than by more salient characters. The dried animal remains in one of the specimens of *B. margaritifera* together with the operculum, and I hope later to examine the dentition of it.

Benthonella gaza Dall

Plate xi, Fig. 5.

Benthonella gaza Dall, Bull. Mus. Comp. Zoöl., xviii, p. 282, June, 1889.

Shell elongated, glistening opaque white, extremely thin, with two and a half larval and five later whorls. Nucleus trochiform, brown, polished, with a single carina above the periphery; other whorls full, rounded, the earlier ones marked with a few faint flexuous transverse waves, the rest with only lines of growth. The whorls are full and rounded, the suture distinct; base full, rounded, with a small umbilicus, in front of which is reflected the thin inner lip; aperture rounded, lip slightly reflected, not thickened. Longitude of shell, 8; of last whorl, 4; maximum latitude of shell, 4mm.

Hab.—Station 2352, west of Cuba, in 463 fathoms, coral; also at Station 2394, between the delta of the Mississippi and Cedar Keys, Florida, in 420 fathoms, mud; temperature 41°.8; Station 2751, south of St. Kitts, West Indies, in 687 fathoms, ooze; temperature 39°.9 F. Station 2754, in 880 fathoms, ooze, east from Tobago; temperature 37°.9; and Station 2760, 90 miles north from Ceara, Brazil, in 1,019 fathoms, broken coral; temperature 39°.4 F.

This species may be regarded as the type. Its polished white rounded simple whorls and brown tip present an elegant appearance.

Family ADEORBIDÆ?

Genus ADEORBIS Wood.

Adeorbis sincera sp. nov.

Plate xii, Fig. 2.

Shell small, depressed, white, with a deep olive epidermis, four-whorled; nucleus not differentiated, smooth, regular; surface of shell polished, sculptured only by incremental lines; whorls full and regularly descending; after the first whorl nearly all specimens have a flattened area in front of the suture, strongest in the apical whorls, where it is usually bounded in front by a sharp carina or angle on the whorl; this decreases and is nearly obsolete on the last whorl; in the same way the umbilicus is generally bounded by a well-marked angle which is visible even on the margin of the aperture, and is less prominent on the adult than in the young; other specimens have the whorls evenly rounded; umbilicus wide; aperture complete, continuous, nearly circular, except at the upper end of the outer lip where it joins the body, where there is a slight angle; young and strongly carinate specimens show angles in the margin corresponding to the carina. Maximum diameter, 3.25; minimum diameter, 2.5; altitude, 2.6mm.

Hab.—Station 2668, off Fernandina, Florida, in 294 fathoms, shelly bottom; and Station 2756, off the Para River, Brazil, in 391 fathoms, sand; temperature 40°.4 to 46°.3 F.

This shell is very like *Valvata sincera*, though smaller and of an olivaceous brown when perfect. The aperture is sometimes slightly thickened inside, so it may prove to be a *Mölleria*. I have not seen the operculum and the generic reference is merely provisional.

I regard the genus *Adeorbis* as closely related to *Skenea*, with which it may possibly be necessary to unite it. But though the type is Rissoid, doubtless numerous species belonging to the *Cyclostrematida* or other Trochoid groups may have been referred to it in the absence of the soft parts.

Family CALYPTRÆIDÆ.

Genus **MITRULARIA** Schumacher.

Mitrularia equestris Linné.

Collected at the Abrolhos Islands, Brazil.

Genus **CREPIDULA** Lamarck.

Crepidula (Sandalium) aculeata Gmelin.

Collected at Station 2762, east of Rio Janeiro, in 59 fathoms; Stations 2764 and 2765, in 10 to 12 fathoms, off the Rio de la Plata.

Family CAPULIDÆ.

Genus **CAPULUS** Montfort.

Capulus incurvatus Gmelin.

Collected at the Abrolhos Islands, Brazil.

Family AMALTHEIDÆ.

Genus **AMALTHEA** Schumacher.

Amalthea effodiens Carpenter.

Collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms, gravel.

Amalthea antiquata Linné.

Amalthea costellata Carpenter.

The preceding two species were found at the Abrolhos Islands, near Porto Allegre, North Brazil.

Family NATICIDÆ.

Genus **NATICA** Lamarck.

Natica canrena Lamarck.

Collected at Station 2762, east from Rio Janeiro, in 59 fathoms, mud, and Station 2765, off the Rio de la Plata, in 10½ fathoms; temperature 57°.1 F.

Natica maroccana Dillwyn.

Obtained at Station 2751, in 687 fathoms, ooze, south of St. Kitts, West Indies. Probably adventitious from shallower water.

Subgenus LUNATIA Gray.

Lunatia fringilla Dall.

Natica fringilla Dall, Bull. Mus. Comp. Zoöl., IX, p. 93, September, 1881.
Lunatia fringilla Dall, *op. cit.*, XVIII, p. 295, Pl. XXI, Fig. 12, 1889.

Collected at Station 2754, east of Tobago, in 880 fathoms, ooze, and Station 2756, off the Para River, Brazil, in 391 fathoms, sand; temperatures 37°.9 and 40°.4 F.

Superfamily DOCOGLOSSA.

Family ACMÆIDÆ.

Genus ACMÆA Eschscholtz.

Acmæa melanoleuca Gmelin.

Collected abundantly at the Abrolhos Islands, near Porto Allegre, North Brazil. It extends northward to Florida.

Superfamily RHIPIDOGLOSSA.

Family COCCULINIDÆ.

Genus COCCULINA Dall.

Cocculina Beanii Dall.

Collected at Station 2754, east from Tobago, in 880 fathoms, ooze; temperature 37°.9 F. *Tectura aduncа* Jeffreys, as far as one can tell from an examination of the shell alone, is a synonym of this species.

Cocculina pocillum sp. nov.

Shell small, stout, short, high, arched in front, bluish white, with a dark-brown epidermis; ends evenly rounded, sides nearly straight on the margin; sculpture of numerous larger obscure radii, each pair with about three finer intercalary ones, slightly scalloped by the very fine slightly raised incremental lines; over all where the surface is perfect is a fine, dust like, microscopic granulation; margin entire; apex projecting backward, decurved in the posterior third of the length; the summit arched slightly above it; interior bluish white, polished; maximum longitude, 5.5; latitude, 3.7; altitude, 3.5; apex in front of hinder margin, 1.5mm.

HAB.—With the preceding species.

This species is not much like any of those previously described. Two male specimens were taken, each with a well marked verge extending from the right tentacle. It has no posterior epipodial filaments, and therefore should be placed in the section or subgenus *Coccopygia*.

Family TURBINIDÆ.

Genus **ASTRALIUM** Link.

Astralium americanum Gmelin.

Collected at the Abrolhos Islands, Brazil, and extending thence northward to Florida.

Family TROCHIDÆ.

Genus **OMPHALIUS** Philippi.

Omphalius fasciatus Born. (var.)

Collected at the Abrolhos Islands.

Genus **CANTHARIDUS** Montfort.

Subgenus HALISTYLUS Dall.

Shell small, cylindrical, holostomate, polychromatic; operculum multispiral, coriaceous; dental formula $\frac{1}{7+1+7}$; type, *H. columna* Dall.

This group differs from *Leiopyrga* in its holostomate aperture and absence of spiral sculpture.

Halistylus columna sp. nov.

Plate IX, Fig. 7.

Shell small, subcylindrical, blunt-tipped, polished; yellow, brown, salmon-colored, bluish gray, or streaked or banded with these colors; seven whorled; apex flattish; nucleus not differentiated, small; whorls, after the second, nearly equal in diameter; suture much appressed, the whorl somewhat constricted in front of it; sculpture only of faint incremental lines; base rounded; aperture rounded ovate, slightly oblique; outer lip continuous with the pillar, which is raised, arched in harmony with the lip, but not reflected; no umbilicus; lip simple, hardly thickened; a little callus on the body and in the posterior angle between the lip and body; throat simple, very slightly pearly; operculum circular, externally shaggy, with many whorls; animal with long slender tentacles; the eyes black, on separate rather long peduncles; epipodial line indicated by four or six short stout papillæ; foot short and broad; muzzle rather large and long, a little indented in the middle line; median and admedian teeth simple, with narrow straight stems, and simple, wide, mushroom-like cusps; uncini numerous, filiform; admedian teeth four, the outer ones the larger; stems and bases of the middle part of the radula so small and thin as to be difficult to distinguish; maximum longitude of shell, 5.8; maximum latitude, 1.9; longitude of aperture, 1.2mm.

HAB.—Station 2762, off Rio Janeiro, in 59 fathoms, mud; temperature 57° F.; Stations 2764 and 2765, off the Rio de la Plata, in 10 to 12 fathoms, sand.

This singular little shell appears to be the only representative on the shores of America of the Australasian *Baukiria*. The tentacles did not appear ciliated, nor could I observe any cephalic lappets between them. The difficulties of observation, however, are so great with so minute an object that their absence can not be dogmatically affirmed merely from an examination of alcoholic specimens.

Genus **GAZA** Watson.

Gaza Watson, Jour. Linn. Soc., XIV, p. 601, 1879; *Challenger* Gastr., p. 93, 1885. Type *G. dædala* Watson.

Gaza Rathbuni Dall.

Plate VII, Fig. 4.

Gaza Rathbuni Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 354, June, 1889.

This species differs from its nearest ally among those already known (*G. superba* Dall) by being more depressed, with stronger spiral grooving, a slightly smaller umbilicus, and more flattened over the sutures. The single specimen obtained has not yet formed the reflected lip and callus over the umbilicus. Maximum altitude of shell, 24; maximum latitude, 38mm.

Operculum of about seven whorls, thin and polished, slightly centrally concave, with a narrow thinner band marginating the coil. It has a maximum diameter of 16mm.

HAB.—Station 2818, near the Galapagos Islands, in 392 fathoms, sand; bottom temperature 44° F.

As the specimen of this fine species is not quite mature it has been figured in a position which will enable it to be compared with *G. superba* and other species of the genus. The soft parts recall those of *G. superba* Dall, but the muzzle seems shorter and there are seven slender, rather long epipodial filaments on the right side, instead of five as in *G. superba*. The intestine is crammed with foraminifera. The pointed tail-end of the foot, in the contracted animal, is turned directly down and in, so that the angles of the fold stand out and at first give the impression that the foot is bifid, behind.

Subgenus CALLOGAZA Dall.

Callogaza Watsoni Dall.

C. Watsoni Dall, Bull. Mus. Comp. Zoöl., IX, p. 50, 1881; XVIII, p. 356; Pl. XXII, Figs. 7, 7*a*, 1889.

HAB.—Antilles, between Florida Strait and Barbados, in 84 to 640 fathoms, *Blake* expedition. Station 2756, in 391 fathoms, sand, off the Para River, Brazil; temperature 40°.4 F.

This extends the known range southward about 1,000 miles.

Genus **CALLIOSTOMA** Swainson.

Calliostoma platinum sp. nov.

Plate VII, Fig. 2.

Shell large, thin, polished, iridescent white, with seven whorls beside the nucleus; nucleus minute, lost; subsequent whorls slightly flattened behind the periphery, full and rounded on the base; longitudinal sculpture of obscure spiral lines behind the periphery and somewhat stronger flattish threads, separated by shallow grooves, on the base; at the periphery is a single prominent thread, immediately in front of which is the suture, the succeeding whorl being appressed against the thread; the single specimen obtained has a second prominent thread about two millimeters behind the peripheral one on the last whorl, but it is probable that the development of this thread was stimulated by an injury of which traces are plainly visible just before the second thread begins; base full and rounded; aperture rounded quadrate; the outer lip thin and sharp, its plane oblique and slightly flexuous; body with a very faint wash of callus; pillar slender, pearly, slightly arched, very little reflected, simple; interior polished, iridescent, without liræ; the external sculpture faintly perceptible owing to the tenuity of the shell. Maximum longitude of shell, 32; maximum latitude, 29^{mm}.

HAB.—Station 2839, near the Santa Barbara Islands, California, in 414 fathoms, sand; with *Turcicula Bairdii*.

The operculum of this species has about fourteen very narrow whorls, is polished internally and somewhat rough externally from the projecting margin of the coils. It bears about the same proportion to the aperture as in the shallow water species. The shell itself is less attractive than most of the group, but indicates that some individuals of the species may have a delicate pale iridescence. The exterior of this specimen shows little pearliness and is chiefly of a somewhat livid white, like the eye of a boiled fish.

The soft parts are whitish; the head and the sides of the foot below the epipodial line are profusely granulose; among the granules rise pointed larger papillæ, also very granulose, so as to appear almost arborescent. The epipodial line projects moderately, with a finely fringed edge. There are two moderate sized filaments in front of the operculum and two smaller ones beneath it. The foot is long, rather narrow, double-edged, and somewhat auriculate in front, with a wide transversely rugose median channel behind the operculum about the tail. The oral surface is granulous, the corners are a little produced. The tentacles are long and slender, the eyes very large and black. There are no palmettes. The gill resembles that of *Turcicula*, but is less triangular as a whole. The mantle margin is finely papillose. The jaws are small and not remarkable. The dentition was not examined.

Calliostoma tæniatum Wood.

Trochus tæniatus Wood, Ind. Test. Suppl., Pl. v, Fig. 12, 1828; Phil. Mon., Trochidæ, p. 251, t. 37, Fig. 12.
Trochus bicolor Lesson; Voy. Coq., p. 345, t. 16, f. 3.

Hab.—Falkland Islands (Philippi). Station 2770, in 58 fathoms, sand, off Spring Bay, east coast of Patagonia, and also at Station 2771, off Point Gallegos, in 50 fathoms, sand; temperature 49°.4 F.

This species is referred to *Photinula* by H. & A. Adams, but appears to be simply a smooth *Calliostoma*. There is no umbilical callus as in *Photinula cærulescens*, which was also obtained by the *Albatross* at Stations 2770 and 2771.

Calliostoma Coppingeri Smith.

Plate xii, Fig. 4.

Trochus (Ziziphinus) Coppingeri E. A. Smith, Ann. Mag. Nat. Hist., Ser. 5, Vol. vi, No. 34, p. 320, Oct., 1880.

Shell glistening, small, flattened at the periphery, seven-whorled; color pale waxen white, with pinkish nacre; the exterior on the spiral sculpture more or less articulated, with elongated brown spots; these are sometimes wholly absent, but disappear last on the carinal threads; nucleus white, small, subglobular, polished, not sculptured; early whorls spirally threaded, the two threads next in front of the suture granulous; these and all the others become flattened out and obsolete on the last whorl or two of the adult in most cases, but are exceptionally retained; the periphery of the whorls is angulated but not keeled; in front of it is another angle on which the suture is laid; the space between is flattened and nearly vertical, becoming more inclined on the last whorl; transverse sculpture of inconspicuous incremental lines, rarely emphasized; base moderately convex; the umbilical region impressed and surrounded by three or four coarse, often articulated spiral threads; outer lips thin, sharp, rounding to the columella without noticeable interruption; pillar somewhat arched, pearly, rather strong; body with a faint wash of callus; operculum amber-colored, thin, multispiral. Maximum altitude of shell, 10; diameter, 11mm.

Hab.—Stations 2765, 2766, in 10 fathoms, sand, off the Rio de la Plata, and 2768, off Cape Delgado, in 43 fathoms, sand.

This shell was at first supposed to be new, but it is probably the unfigured species described by Mr. Smith from 28 fathoms off the mouth of the Rio de la Plata in latitude 36° 47′ S.

This species has much such a surface as *C. yucatecanum* Dall, which, however, is umbilicated. There is a small swelling, hardly a tooth, at the end of the pillar. Its colors look washed out; otherwise they also recall those of *C. yucatecanum*. There are no liræ in the throat. Occasional specimens have the spiral sculpture emphasized; in such cases the flattening of the periphery becomes less prominent. Now and then

one of these strongly sculptured forms has all the threads behind the periphery undulated or granulous, forming a variety which may be called *C. Coppingeri* var. *cymatum*.

Calliostoma riöensis sp. nov.

Plate XII, Fig. 5.

Shell of a waxen color, nearly obscured by clouds, flammules, and articulations of lighter or deeper flesh color; whorls eight, somewhat flattened above, angulated around the base, spirally granulosely threaded; apex pointed; nucleus small, white, dextral; spiral sculpture of alternately larger and smaller threads, of which at the beginning of the last whorl there are six each between the sutures; the paired thread on which the suture runs and the next primary behind it are distinctly wider than the other primaries; all are set with close rounded granules, which are only moderately prominent; the interspaces are about as wide as the secondary threads; the base has about a dozen rather strong spirals, with subequal interspaces, but no secondary finer threads; transverse sculpture only of lines of growth; the whorls and base are only slightly convex; aperture subquadrate, the outer lip sharp; pillar stout, short, a little angulated at its anterior point, pearly, and hardly reflected over the imperforate umbilical region. Maximum altitude of shell, 15; maximum diameter of base, 14mm.

HAB.—Rio Janeiro, on the Encuados Islets, U. S. Exploring Expedition. *Albatross* Expedition at Station 2762, off Rio, in 59 fathoms, mud; temperature 57°; Stations 2764 and 2765, off Rio la Plata, in 10 to 12 fathoms, sand.

This species recalls *C. jucundum* Gould, from New Zealand, and *C. euglyptum* Adams, from Florida, but is sufficiently distinct from either. It is less elegantly painted than *C. jucundum*, and the same may be said of its relation to the finer specimens of *C. euglyptum*, which also has its whorls more rounded and its flammules more regular.

C. riöensis is very apt to be overgrown with Polyzoa; few of the specimens are free from them. The operculum and soft parts are as usual in the group.

Genus MARGARITA Leach.

Subgenus TURCICULA Dall.

Turcicula Dall, Bull. Mus. Comp. Zoöl., IX, p. 42, 1881.

This group is remarkable among Trochidæ for its large size and thin shell with delicate green epidermis and reflected peristome like a land shell. The type of the group is small compared with the others now known, but has the characteristic surface sculpture and form, though no perfectly adult and complete specimen has yet come to hand. The voyage of the *Albatross* has given us two fine species from the Pacific belonging to this group, which are perhaps the finest mollusks collected during the voyage.

Turcicula Bairdii Dall.

Plate VII, Fig. 3.

Turcicula Bairdii Dall, Bull. Mus. Comp. Zoöl., XVIII, pp. 376–378, June, 1889.

Shell large, turbinate, elevated, thin, inflated, with four and a half or five whorls, of which the last is much the largest; surface apt to be eroded, but where perfect covered with an extremely thin dense vernicose pale apple-green epidermis; whorls inflated; suture deep, not channeled; apex moderately pointed; spiral sculpture of (1) numerous fine faint rather irregular scratches or impressed lines; (2) sparse slightly elevated revolving bands which are usually more or less nodulous, the nodules when prominent being sharp and laterally flattened as if pinched up; of these there are, on the upper whorls usually three series between the sutures, of which one at the periphery is the most prominent and persistent, the next one behind it, half way between the periphery and the suture, being the least marked; on the base the cinguli are six or seven in number, becoming narrower toward the axis, smaller than those behind the suture, with smaller, less prominent, rounder and more numerous nodules; there is some variation in number and strength of all the cinguli, but that on the periphery is the most prominent and constant; the whorls are particularly round and inflated above and below, so that the outline of the aperture is often nearly circular; interior of the aperture brilliantly pearly, a thin wash of callus on the body; the outer lip very slightly thickened and distinctly reflected in the adult; pillar thin, simple, arching roundly into the curve of the base without any interruption, angle, or tooth; axis imperforate; the external sculpture showing through the thin shell. Altitude 50; maximum diameter 42mm. Maximum diameter of operculum 18mm, with about twelve whorls. The operculum is externally polished, smooth and deeply concave; the inner side presents a minute central rounded elevated point; the margin is very thin but entire.

Hab.—Station 2839, off San Clemente Island, California, in 414 fathoms, sand; bottom temperature not registered.

Soft parts.—The sides of the foot below the epipodial line are granulous; above the line the surface is rather smooth. Much of the surface is apt to be covered with a layer of blackish or olivaceous substance, like solidified mucus or paint, which seems to belong to the animal, yet is wholly external to the enticle. The foot is broad, not very long, bluntly pointed behind, the front edge straight, double, the lateral angles pointed; the upper layer of the edge is smooth and turgid in most of the specimens; it is not indented in the median line.

The muzzle is stout, circularly wrinkled, a little expanded at the disk; the oral disk is not marginated; its surface is finely granulose; it is angulated at its lower outer corners and medially indented below. There are no oral palps or tactile appendages.

The cephalic tentacles, for the size of the animal, are small and short. At their inner bases are small "palmettes," or cephalic epipodial fringes, not quite meeting in the middle line. They are rounded, with papillose edges. At the outer bases of the tentacles are the eyes, large, oliviform, mounted on short pedicels. The pigmented portion itself is ovoid and not hemispherical. In some specimens the pigment seems to be more extensive on the under side, in others the reverse, and still others have it equally distributed. A lens and aqueous humor are distinctly observable. At the right side, behind and on a level with the eye, is a short tubular verge. The anterior epipodial side lappet does not appear to be modified into a seminal conduit, as in *Margarita infundibulum* Watson. These lappets are nearly symmetrical. Their bases are turned up a little on each side behind the eyes and the lappets are rather wide. They extend backward about two-thirds of the way to the operculum, with a finely papillose edge. Then comes a single tentacular filament, less than half as long as a cephalic tentacle. There is another stretch of edge fringed with only small papillæ; under the operculum there are three long filaments, of which the posterior is longest. Behind the operculum the epipodial lines of the two sides approach each other and bound a median furrow, coarsely transversely ridged (as in *Pleurotomaria*), which extends to the end of the foot.

The mantle edge is smooth or very sparsely papillate, slightly thickened. The free end of the intestine projects on the right side over the neck, with its termination constricted by a sphincter, and then expanded into a cup-shaped circular foramen. On the left side is the gill, consisting of a central, somewhat muscular, ensiform basement, from which depend two sets of elongate triangular lamellæ, separated by a narrow ridge. The left-hand set are slightly the longer. Most of the gill is free. Its distal end is pointed and the lamellæ hang side by side, with the ridge between the two series, as in *Nucula*. The intestine takes a curve to the left side, where the renal gland is visible between it and the gill. I observed no osphradium.

The mouth is small. A short distance behind it is a deep radular diverticulum. The jaws are small, triangular, and dark brown. The gullet opens almost directly into an elongate, large, longitudinally wrinkled stomach. Behind it the very large intestine, with longitudinally striated walls, extends backward about half a whorl, then turns upward and forward for a third of a whorl; then back again upon itself about the same distance; then forward to its anal termination, above described.

The liver and seminal gland appear to resemble those of ordinary Trochids.

The operculum is amber-colored, polished, thin, and centrally depressed. It has about a dozen whorls. The opercular pad is ovoid and rather small.

The radula is quite small and the anterior part dark brown. The

intestine, in all the specimens, is crammed with a greenish mud, consisting of disintegrated foraminifera.

The dentition recalls that of *Calliostoma*, *Solariella*, *Margarita*, etc., and presents nothing very characteristic.

The central tooth has a broad thin base, subrectangular, and a little wider at the anterior corners. The stem of the cusp and the cusp are narrow. The latter is simple, rather small, short, and recurved. It is not denticulate. There are three or four admedian or lateral teeth, rather long, with small bases, rather broad, simple, moderately curved brownish cusps. There are about twenty-five uncini, half of which spring from lozenge-shaped bases, looking like a pavement; are long, narrow, slender, moderately curved, with spatuliform tips. One edge of these tips is microscopically serrate, and below the serrate part, on the same side, is a single larger denticle, standing out like a short thumb.

The external uncini are thin, flat, wide, and hardly curved. Their distal ends are flat and broad, with the edge simple and entire. These teeth gradually diminish in size and width, as usual in *Trochidæ*. The formula would be $25+3+\frac{1}{1}+3+25$, or very nearly that; but time has been wanting in which to undertake the laborious task of an exact enumeration of these minute and tangled objects, of which the general features have just been recorded.

All the specimens of *Turcicula* previously obtained were incomplete and deprived of epidermis.

The capture of this and the following species, besides adding to our catalogues two of the finest deep sea mollusks known, has enabled me to fully describe the characters of the group and determine its place in the system of classification.

Turcicula Macdonaldi sp. nov.

Plate VII, Fig. 7.

Shell very large, thin, elevated, with about six whorls, flattened, and appressed above and rounded below. It differs from *T. Bairdii* in the proportionally narrower cinguli of which only that at the periphery is nodulous, in the more numerous (nine to ten) sharper and more elevated basal cinguli, in the flatter posterior surface of the whorl and its being appressed at the suture, in its duller more olivaceous epidermis, more angulated and less reflected outer lip. Although living it was a good deal eroded, especially at the tip. Altitude of decollate shell, 75; maximum diameter, 60^{mm}. The operculum has nine whorls, is of the same shape as in the preceding species, but of a darker brown, with a maximum diameter of 29^{mm}.

Hab.—Station 2792, off Manta, Ecuador, in 401 fathoms, mud; bottom temperature, 43° F.

The single specimen of this magnificent shell contained the animal, which does not appear to differ materially from the *T. Bairdii*. It is

named in honor of Col. Marshall McDonald, the present U. S. Fish Commissioner, under whose direction the voyage was carried out.

In this species the "palmettes" or epipodial lobes between the tentacles are proportionally larger than in *T. Bairdii* and have smooth and not fringed edges. The verge is similar but mounted on an onion-shaped expanded base. There is one very short, small, epipodial filament in front of the operculum on each side; under the operculum are two very small, instead of three long filaments as in *T. Bairdii*, on each side. The other features are essentially as in *T. Bairdii*. The renal organ is very extensive, with a corrugated surface, and seems to empty into the rectum shortly before the latter becomes attached to the surface of the mantle.

Subgenus SOLARIELLA A. Adams.

Solariella infundibulum Watson.

Plate IX, Fig. 3.

Trochus (*Margarita*) *infundibulum* Watson, *Challenger* Gastr., p. 84, Pl. v, Fig. 5; Dall, Nautilus, p. 2, May, 1889; *Blake* Gastr., p. 380, June, 1889.

The presence of a verge, or intromittent male organ, has hitherto, among the Rhipidoglossate Mollusks, been recorded only in *Neritina* (Claparède) and certain Limpets. The organ as it exists in *Neritina* and *Nerita* is so short and obscure that its function and even its existence has been called in question. When I showed its existence in the rather anomalous *Addisonia paradoxa* and *Cocculina spinigera*, curious deep sea limpets, it was questioned whether they were not peculiarly modified Tænioglossa.

Since then, in several deep-sea mollusks, such as *Rimula*, *Margarita*, and others indisputably belonging to the *Rhipidoglossa*, I have found a well-developed verge; and there is little doubt that the ancestors of this group, as well as of the *Tænioglossa*, were so provided, and that some of these deep sea forms have retained the organ now generally obsolete in their shallow-water congeners. In combination with this survival, one of the species, *Trochus infundibulum* Watson, offers a singular and very interesting special modification of the anterior portion of the epipodium on the right side, which appears worthy of particular attention.

The soft parts of this species afford several notes of interest. The external parts, except the eyes, are white. The foot is wide, straight, and double-edged in front, and, as far as one can judge from specimens contracted in alcohol, must have been somewhat pointed or produced at its anterior corners in life. The sides of the foot are nearly smooth below the epipodial line.

The muzzle is small and slender at its proximal end, enlarged and transversely semi-lunar at its distal extremity. The oral surface of the muzzle is smooth, the mouth very small; the oral disk is flat and produced on either side into a thin linguiform lappet, with simple and entire edge. These lappets are remarkably long, their ends reaching as far as the ends of the true tentacles, and serve as tactile organs, like

the oral tentacles of the *Lepetidæ*, or the much smaller lappet of *Acmæa*. When not feeding or seeking food, these lappets would seem to be applied to the sides of the foot below the epipodium. The oral disk is entire, but is slightly indented in the median line below a furrow running up toward the mouth.

The cephalic tentacles are very stout and large, very elongate, conical, with moderately pointed tips. They are situated above, and not, as in most *Trochidæ*, on either side of the muzzle. Their inner bases are connate; and there is no inter-tentacular "veil," or any tubercular traces thereof.

The eyes are large, strongly pigmented, ovoid, and sessile on the outer bases of the tentacles, or perhaps I should say, just by the outer bases. They are not pedunculated or elevated on pedicels in any of the specimens examined, and I am quite confident that this is not caused by contraction due to alcohol, but is normal to the species.

The epipodial apparatus is complicated, and exhibits a certain amount of variation between different individuals in the situation and number of its processes. In the males, it is subjected to a remarkable modification for sexual purposes. The epipodium begins immediately behind the eye and a trifle below it. In the females it is produced into a large broadly linguiform process, half as long as the cephalic tentacles and fringed with close-set, uniform, small, pointed papillæ or filaments. This process exists in the males on the left side. The posterior margin then curves in toward the side of the foot; it becomes quite narrow and shows two lateral tentacles of moderate size; then a vacant space; then at the front end of the operculum two or three filaments, small, but larger than any in the vacant space; then another but larger one; and finally another, which is behind the middle of the operculum, and is the last on that side. The epipodial line is continued to the end of the foot, the dorsal surface above it being transversely rugose and with a linear median furrow. On the other (right) side we find a small, a large, two subequal small, and another large filament, followed by a slight gap, and then a still larger tentacular process. The flap, which corresponds to the fringed process on the left side, is remarkably modified in the male.

Behind and close to the right eye is a small tubular, longitudinally striate, cylindrical verge, not exceeding (in alcohol) two millimeters in length. Below it the epipodial flap is enormously produced, and its front edge is rolled upward and backward upon itself, forming a tube into the proximal opening of which the end of the verge may project.

The flap is rolled so that it makes nearly two layers, and thus a very capable cylinder, which, when unrolled and released, will immediately coil itself up again. This cylinder is of subequal diameter throughout, and is as long as, and somewhat stouter than, the cephalic tentacles. Externally, near its base, it is nearly smooth; further out, it is spirally striate; near its extremity, it becomes thicker and rather deeply ex-

ternally grooved longitudinally, with short, even, close-set, slightly spiral grooves. The opening at the distal end is fringed with short, equal papillæ, each one corresponding to the thickened interspace between two of the grooves. These raised folds or interspaces are also finely transversely striate. At the base of the cylinder the epipodium extends backward to the first lateral filament, and the margin of this part is perfectly entire and simple, showing neither fringe nor granulation. The object of this apparatus is self-evident. The cylinder serves as *a conduit for the seminal fluid ejected from the verge.* Whether it may be employed in an actual copulation is doubtful; it may merely serve to spread the seminal matter over the eggs as they are deposited by the female. I am not aware that anything of this sort has been observed in any other gastropod up to the present time.

The edge of the mantle is smooth, entire, and slightly thickened. Within the nuchal chamber the anus is visible on the right side. The end of the intestine for a considerable distance is free from the mantle and projects like a tentacle. The termination is slightly constricted, then enlarged into a cup or trumpet-shaped ending, which nearly reaches the mantle-edge.

The intestine itself, after leaving the stomach, is much convoluted, but in the main rises and is brought forward nearly to the mantle-edge above the stomach; then turns back and is carried far into the visceral coil before it is again brought forward and terminated as above described. The food consists of Foraminifera.

The gill is free, except at its base, and consists of a very elongate-triangular foundation, from which depend triangular lamellæ without a raphe and widest at their bases. These grow larger proximally.

The operculum is thin, polished, amber-colored, centrally depressed, having a central projection or nipple on its under side, and consists of about four whorls.

The specimen affording the above notes has been identified with Mr. Watson's type specimen, and is now deposited with it in the British Museum.

The diagram upon Plate IX (Fig. 3) illustrates the features described, though crudely drawn. The fringe on the left anterior epipodial lappet is too coarse and irregular. The animal is represented as if crawling. The central obliquely lined area represents in section the portion which would extend into the shell, which latter has been omitted to show the parts more clearly. In front on the right, behind the eye, is seen the verge, behind that the distal free end of the intestine. The posterior epipodial filaments may be traced through the operculum.

This species was obtained by the *Challenger* off Pernambuco and also in the North Atlantic. It was dredged in some numbers by the *Albatross* at Station 2723, 125 miles off the coast of the United States, in north latitude 36° 47′, in 1685 fathoms. An allied species, *S. Ottoi* Philippi, seems to be without this curious sexual modification.

I am aware that this examination does not agree in all respects with the account of Dr. Pelseneer in the *Challenger* Report on the Anatomy of Mollusks, but that account appears to have been somewhat hastily prepared, while the figure of the animal is evidently a diagram and not a portrait. There is, of course, a possibility that some error of identification may have occurred, and that the animal sent to Dr. Pelseneer was not that of the *S. infundibulum*. The specimen here described has been compared with the original type of *infundibulum*, and I suppose there can be no question as to its absolute identity specifically.

Solariella amabilis Jeffreys.

Collected at Station 2754, east from Tobago, in 880 fathoms, ooze.

Solariella clavata Watson.

With the preceding species, and also at Station 2751, in 687 fathoms. ooze, south of St. Kitts.

Solariella oxybasis sp. nov.

Plate XII, Fig. 6.

Shell closely related to *S. Ottoi*, var. *regalis* V. & S., from which it differs most obviously by its more acute and elevated spire, smaller umbilicus, angular periphery, and aperture angulated in front by the juncture of the pillar with the end of the umbilical carina; shell thin, pearly, with a pale, thin epidermis and six (or more) whorls without the nucleus; nucleus lost; spire acute, the last whorl enlarging disproportionately; spiral sculpture of, on the spire, three revolving threads, the most anterior strongest and peripheral, the middle one least evident; the base has six subequal, strong, granular threads and two smaller ones, the latter just within the umbilicus; transverse sculpture of, on the last whorl, about eighteen sharp radii, extending to the periphery and forming sharp nodules at the intersections of the spirals; the nodules on the peripheral spiral are the most prominent and are almost spinose on the last whorl; beside this the whole shell is covered with a fine, silky, transverse, slightly irregular striation; suture distinct, running on the first basal spiral, not channeled; umbilicus very narrow, its margin subangulose; aperture quadrate, subangulate at the periphery, in front, behind, and at the junction of the pillar with the body; body with a wash of pearl; margin continuous with the pillar; sharp, thin, reflecting the sculpture; pillar slightly arched, thin, reflected a little behind; base full and rounded, produced in the middle near the umbilicus; altitude 13.5; maximum diameter 12.5; minimum diameter 10^{mm}.

HAB.—Station 2839, in 414 fathoms, sand, off the Santa Barbara Islands, California.

The soft parts recall those of *S. Ottoi* Phil. This species belongs to the group represented by *S. Ottoi*, *S. infundibulum*, etc., but seems dif-

ferent from either of them. The sculpture, though more spinose, and the form of the aperture recall Watson's figure of his *Bembix ævola* in the *Challenger* report (Gastr., Pl. VII, Fig. 13), which, however, has the details of sculpture differently arranged. I should suspect from this that *Bembix* would include this particular group of *Solariella*, all of which have the peculiar silky surface and the same general type of sculpture. The size and carination of the umbilicus, and consequently the form of the aperture, are variable factors in this group of shells.

Trochus alwinæ Lischke has been referred to *Bembix*, but I can see no reason, from the description and excellent figures, why it should be separated from *Calliostoma*. *T. argenteo-nitens* of the same author is much like Watson's *Bembix* as was pointed out by him, though doubtless specifically distinct.

Apropos of *Bembix*, the name was given long since by De Koninck to a remarkable cretaceous land shell like a subspherical decollate *Cylindrella*; the type was examined by me very lately in the Museum of Comparative Zoology at Cambridge, Massachusetts. I have not, so far, had an opportunity of looking up the reference to the description, but according to Fischer (Man. conchyl. p. 827) the name was used and the shell figured in 1861 by Ryckholt. In the form *Bembyx* the name was used by Fabricius for Hymenoptera in 1775, who also printed or misprinted it *Bembex*. It would seem as if the name *Bembix*, as applied by my friend Watson, must be given up. This, however, is of less importance, as the characters given for the group are not sufficient to distinguish it from *Solariella*, or even possibly *Turcicula*. That it may prove, when we know the soft parts, to be distinct, is quite possible, but as yet the characters given for separating it from such species as *Solariella infundibulum* and its allies do not seem very weighty.

Solariella actinophora sp. nov.

Plate XII, Figs. 8, 11.

Shell with a prominent pointed apex, but generally depressed, pearly, with a pale greenish epidermis and six whorls; nucleus glassy, polished, swollen, and slightly tilted; spiral sculpture on the spire of three sharp narrow elevated threads, a finely granular or almost smooth peripheral keel or thread on which the suture runs: on the base three similar less prominent threads, on the anterior of which the pillar lip revolves around the umbilicus, and lastly a very sharp keel, with many strong, sharp nodules, carinating the umbilicus; transverse sculpture on the spire of numerous sharp, elevated, narrow radii, which reach the second spiral counting forward from the suture nodulating both; some of the radii appear to reach the third spiral, but most of them do not, and the nodulations on the third usually alternate with those on the second thread; the nodules are small and pyramidal, the rectangles formed by the reticulations are flattened; beside the primary radii numerous smaller ones start from the suture between the primaries, but rarely

extend beyond the first spiral, except on the last whorl, where they disappear toward the periphery; these secondaries are elevated and sublamellose, very regularly spaced, and re-appear on the base within the two anterior spirals, then overrun the carina and ascend the umbilicus in a vertical direction; whorls full and rounded, except as modified by the sculpture; surface polished; suture deep but not channeled; apical part of the spire rather pointed; base full, angulated at the umbilicus, which is large and deep, with nearly vertical, scalar sides; aperture wide, outer lip rounded, thin, sharp; base angulated by the umbilical carina, strictly continuous with the pillar and outer lip; pillar thin, sharp, not reflected, a little concave above the middle, not anywhere thickened; body without callus; maximum diameter of shell, 9; minimum diameter, 7.25; altitude, 7.25mm.

HAB.—Station 2751, south of St. Kitts, in 687 fathoms, ooze; Station 2754, east from Tobago, in 880 fathoms; and Station 2760, 90 miles north of Ceara, in 1,019 fathoms, broken coral; temperatures 37°.9 to 39°.9 F. It has also been found at Guadalupe in 769 fathoms, sand.

This is nearest *S. ægleis* Watson, which is more conical and has a different sculpture, and especially a much more funicular umbilicus. *S. actinophora* is a larger shell than *S. ægleis*, and attains larger dimensions than are here given, judging from fragments among the dredgings.

Genus **BASILISSA** Watson.

Basilissa alta Watson.

Collected with the last species at Stations 2751, 2754, and 2760.

Family DELPHINULIDÆ.

Genus **LIOTIA** Gray.

Liotia Riisii Dunker.

Collected at Station 2758, 90 miles southeast from Cape San Roque, in 20 fathoms, shelly bottom.

Family CYCLOSTREMATIDÆ.

Genus **CYCLOSTREMA** Marryat.

Cyclostrema cistronium Dall.

Plate XI, Fig. 11.

Cyclostrema cistronium Dall, Bull. Mus. Comp. Zoöl, XVIII, p. 394, June, 1889.

Shell small, white, with a polished nucleus, one and a half rounded and as many more carinated whorls; spire depressed; radiating sculpture of fine, close, flexuous threads, which appear chiefly in the interspaces of the spirals, giving the surface a minutely punctate appearance; these extend over the whole surface except of the nuclear whorls; spiral sculpture of, on the summit, seven or eight, between the carinæ six or eight, and on the base ten or fifteen extremely fine threads, even

and uniform, with about equal interspaces, some a little granular from the radiating sculpture; beside these there are three very strong carinæ; one forms the margin of the nearly flat spire, the second extends horizontally just below the periphery, the space between them deeply excavated; the third forms the edge of the funicular narrow deep umbilicus. The base is conical, excavated just within the peripheral carina; it rises to the edge of the umbilicus, which is marked by a strong thread, and within is vertically striated. The last whorl descends from the plane, and finally becomes separated from the body whorl; the margin is simple, sharply angulated by the carinations, otherwise the aperture would be ovate, with the columellar side somewhat excavated. Altitude, 1.6; maximum diameter, 2mm.

HAB.—Off the coast of North Carolina, in 22 to 63 fathoms, sand and gravel, at U. S. Fish Commission Stations 2595, 2598, 2608, 2610, and 2612, the temperature varying from 67° to 78° F.

This is a very strongly marked species, in its sculpture recalling *C. Verreauxi* Fischer, which is larger, less elevated, with a proportionally larger umbilicus, and has not the deflected aperture. The latter recalls the characters of *Tubiola divisa* J. Adams, which is otherwise very different.

Cyclostrema pompholyx Dall.

C. pompholyx Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 394, Pl. XVIII, Fig. 9, June, 1889.

This species was originally obtained in the Gulf of Mexico, in 805 fathoms, by the *Blake* expedition, and Dr. Rush obtained a young specimen in 780 fathoms, mud, off Cuba. A specimen with a maximum diameter of 6 and a height of 4.5mm was dredged by the *Albatross* at Station 2754, in 880 fathoms, ooze, off Tobago; bottom temperature, 37°.9 F. This considerably extends the known range southward.

Cyclostrema valvatoides Jeffreys.

Collected at Station 2760, 90 miles north from Ceara, Brazil, in 1,019 fathoms, broken coral; temperature 39°.4 F.

Cyclostrema diaphanum Verrill.

Obtained at Station 2752, off Santa Lucia, in 281 fathoms, sand; temperature 48° F.; and also at Station 2760, with the preceding.

Superfamily ZYGOBRANCHIA.

Family HALIOTIDÆ.

Genus **HALIOTIS** Linné.

Haliotis Pourtalesii ? Dall.

Plate XII, Figs. 1, 3.

H. Pourtalesii Dall, Bull. Mus. Comp. Zoöl., IX, p. 79, 1881; XVIII, p. 395, 1889.

Shell small, of a pale brick-red color, with white dots on some of the spirals, rather elevated, with about two and a half whorls; apex small,

prominent; holes about twenty-five, of which five remain open, the margins of these rather prominent; outside the row of holes the usual sulcus is strongly marked; about midway from the suture to the line of holes is a raised rib, rather obscure, but differing in different individuals and corresponding to an internal sulcus; between the central ridge and the suture there are no undulations or transverse ridges of consequence; sculpture of well marked, rather flattish, spiral, close-set threads, sometimes with a single finer intercalary thread, overlaid by smaller rather compressed transverse ridges, in harmony with the incremental lines; on top of the spirals the ridges bulge like the threads of worsted on canvas embroidery; spire situated well forward and with subvertical sides; interior pearly, the coil of the spire rather close and the margin of the pillar flattened. Longitude of shell, 23; latitude, 18; altitude, 11.5; nucleus behind the anterior end, 17^{mm}.

Hab.—Station 2815, in 33 fathoms, sand; near Charles Island, of the Galapagos group, in the Pacific.

The nearest relative of this shell is *H. parva*, from the Cape of Good Hope, which differs from our specimens chiefly in the greater prominence of the central rib, and in being a little more circular in outline.

The shell from the Galapagos agrees so exactly with what we know of *H. Pourtalesii* and with my own recollection of the type specimen destroyed in the Chicago fire, that I am unwilling to separate it, though the distance between the two localities is so great.

The occurrence of this shell at the Galapagos is of great interest apart from its supposed connection with the Floridian species. No species of *Haliotis* is known from the west coast of South America, of Central America, or of North America south of northern Mexico. There are one or two small not nearly related species in the Melanesian Islands and north Australia. So the present species is remarkably isolated. Nothing of the sort has been previously recorded from the Galapagos. Two specimens were obtained, neither containing the soft parts. The original type of *H. Pourtalesii* contained the animal. It would probably be referred to the section *Padollus*.

Family FISSURELLIDÆ.

Genus **PUNCTURELLA** Lowe.

Puncturella circularis Dall.

Collected at Station 2754, in 880 fathoms, ooze; east from Tobago; temperature 37°.9 F.

Puncturella falklandica A. Adams.

Collected at Station 2785, in 449 fathoms, mud, on the west coast of Patagonia; temperature 47° F.

This species is amazingly like *P. noachina*; the only differences I have been able to see in the shells are that in *P. noachina* the fissure is generally longer, the septum longer and less vertical, and the apex more

posterior. The sculpture seems essentially similar. I have not been able to give the time necessary for a critical examination of the soft parts of the two forms. The animal of *P. falklandica* was remarkable in one respect. Among the specimens collected at this station, all of which possessed the soft parts, some had well pigmented black eyes, while in others the pigment was absent and the organs therefore must have been useless. The males possess a well marked verge in the vicinity of the right tentacle, thus adding to the now very respectable list of *Rhipidoglossa* which possess an intromittent male organ.

Subgenus FISSURISEPTA Seguenza.

Fissurisepta triangulata Dall.

Puncturella (*Fissurisepta*) *rostrata* Watson, Chall. Rep. Gastr., p. 48, Pl. IV, Fig. 10, 1885. Not of Seguenza.

Fissurisepta triangulata Dall, Bull. Mus. Comp. Zoöl., XVIII, p. 404, June, 1889.

HAB.—Station 2358, off Cozumel Island, coast of Yucatan, in 222 fathoms, coral; and Station 2668, off Fernandina, Florida, in 294 fathoms, gravel; temperature, 46°.3 F.

This species is more triangular and erect, less elevated and longer than Seguenza's original *rostrata*, with typical examples of which the present species has been carefully compared.

Subgenus RIMULA Defrance.

Puncturella (? Rimula) erecta Dall.

Puncturella erecta Dall, Bull. U. S. Nat. Mus., No. 37, p. 170, No. 1077, August, 1889.

Shell stout, erect, high, rather short, white or grayish, reticulated; apex minute; nucleus smooth, of a single whorl; radiating sculpture of three series of threads, the strongest alternating with the secondaries and these with the tertiaries, which last are almost hidden under the concentric sculpture, which consists of round, even, uniform, equally-spaced threads clinging closely to and passing over the radii like cords over a rod; apex at the posterior third, from which the posterior slope is straight and steep; anteriorly the top is arched, then falls steeply to the front edge; slit elongate, with its outer edges raised, a suture in front continued to the front edge, corresponding to an internal groove which does not indent the margin; perforation long and narrow, contained in the upper half of the anterior dorsum; internally there is no true septum, but a rim of shelly matter like a collar is pushed back behind the orifice as if the latter had been made by pushing a pin in from the outside and pressing it backward; interior of shell white, muscular impression strong, margin of shell slightly crenulated by the sculpture; maximum longitude of shell, 10; latitude, 7.5; altitude, 6.8^{mm}.

HAB.—Station 2601, in 107 fathoms, off Cape Hatteras, North Carolina; temperature, 67°.4.

This is one of those intermediate forms which bridge over the gaps between subgenera. It has exactly the sculpture of some varieties of *Cranopsis asturiana*, but its apex is smaller and more close-set, the form of the shell different, the perforation nearer the apex of the shell, and the shell itself is solid and strong, while the *C. asturiana* is delicate and thin. It is difficult to say whether the present species should be called a *Puncturella* (s. s.), a *Cranopsis* or a *Rimula*.

Subgenus CRANOPSIS Adams.

Cranopsis asturiana Fischer.

Collected at Station 2666, in 270 fathoms, sand, off Fernandina, Florida; and at Station 2750, in 496 fathoms, off St. Bartholomew, West Indies; temperature 48°.3 and 44°.4 F.

Genus **EMARGINULA** Lamarck.

Emarginula tumida Sowerby.

Collected at Station 2758, 90 miles southeast from Cape San Roque, Brazil, in 20 fathoms.

Subgenus SUBEMARGINULA Blainville.

Subemarginula octoradiata Gmelin.

Collected at Port Castries, Santa Lucia, West Indies, and at the Abrolhos Islands, near Porto Allegre, North Brazil.

Genus **FISSURELLA** Bruguière.

Fissurella alternata Say.

Not rare at the Abrolhos Islands, Brazil.

Subgenus GLYPHIS Carpenter.

Glyphis barbadensis Gmelin.

Collected at the Abrolhos Islands, Brazil.

Genus **FISSURELLIDEA** Orbigny.

Fissurellidea limatula Reeve.

Collected at Station 2765, in 10½ fathoms, sand, off the Rio de la Plata, from whence it ranges northward to the coast of North Carolina.

EXPLANATION OF PLATES.

When an asterisk is attached to a figure it indicates that the species was obtained in the Pacific Ocean. All those without an asterisk are Atlantic species. The figures following the name indicate the longest dimension of the actual shell represented as figured, in millimeters.

PLATE V.

FIG. 1. *Chrysodomus (Sipho) Rushii* Dall, 11.0; p. 323.
2. *Nassa scissurata* Dall, 12.0; p. 326.
3. *Conomitra intermedia* Dall, 15.5; p. 316.
4.* *Columbella permodesta* Dall, 14.0; p. 327.
5. *Mesorhytis costatus* Dall, 14.0; p. 317.
6.* *Chrysodomus griseus* Dall, 32.0; p. 322.
7.* *Pleurotoma? exulans* Dall, 32.0; p. 302.
8.* *Calliotectum vernicosum* Dall, 48.0; p. 304.
9. *Terebra benthalis* var. *nodata* Dall, 18.5; p. 299.
10.* *Chrysodomus amiantus* Dall, 76.0; p. 321.
11. *Mangilia antonia* Dall, 18.0; p. 304.

PLATE VI.

FIG. 1.* *Leucosyrinx Goodei* Dall, 80.0; p. 300.
2.* *Pleurotomella cingulata* Dall, 73.0; p. 306.
3.* *Leucosyrinx persimilis* Dall, 80.0; p. 301.
4.* *Pleurotomella (Gymnobela) agonia* Dall, 16.0; p. 301.
5.* *Pleurotomella argeta* Dall, 43.0; p. 307.
6. *Fusus ceramidus* Dall, 46.5; p. 318.
7.* *Chrysodomus aphelus* Dall, 30.0; p. 323.
8. *Nassarina columbellata* Dall, 12.2; p. 325.
9.* *Buccinum viridum* Dall, 46.0; p. 320.

PLATE VII.

FIG. 1.* *Murex (Chicoreus) Lecanus* Dall, 70.0; p. 329.
2.* *Calliostoma platinum* Dall, 32.0; p. 343.
3.* *Turcicula Bairdii* Dall, 50.0; p. 346.
4.* *Gaza Rathbuni* Dall, alt. 24.0; p. 342.
5. *Fusus apynotus* Dall, 24.0; p. 318.
6. *Fusus alcimus* Dall, 15.0; p. 319.
7.* *Turcicula Macdonaldi* Dall, 75.0; p. 348.

PLATE VIII.

FIG. 1.* *Verticordia perplicata* Dall, 33.0; p. 278.
2. *Pecten glyptus* Verrill, right valve, 60.0; p. 248.
3. The same, interior, showing radii.
4. *Poromya cymata* Dall, 9.0; p. 289.
5. *Cuspidaria monosteira* Dall, 5.0; p. 281.
6. *Poromya microdonta* Dall, alt. 11.5; p. 290.
7.* *Lyonsiella radiata* Dall, 13.0; p. 276.
8.* *Poromya (Dermatomya) mactroides* Dall, 18.0; p. 291.
9.* *Cryptodon barbarensis* Dall, 17.0; p. 261.

PLATE IX.

FIG. 1.* *Dentalium megathyris* Dall, 95.0; p. 293.
2. Floating ovicapsule of *Scaphella? brasiliensis* Sol.; 50 by 55mm; p. 312.
3. *Solariella infundibulum* Watson, ♂, enlarged diagram of the soft parts, with the shell removed; the operculum *in situ*; p. 349.
4.* *Voluti lithes Philippiana* Dall, 36.5; p. 313.
5. *Scaphella magellanica* Sowerby, larval shell, from ovicapsule dredged at Station 2779, enlarged; 11.0; p. 311.
6. *Scaphella magellanica* Sowerby, ovicapsule on valve of *Pecten*. The diameter of the base of the capsule is about 28.0; p. 311.
7. *Halistylus columna* Dall (much enlarged). 5.8; p. 341.
8.* *Cadulus albicomatus* Dall, 24.0; p. 295.

PLATE X.

FIG. 1. *Callocardia* (*Vesicomya*) *Smithii* Dall, interior of left valve, 28.0; p. 268.
2. The same, hinge of right valve.
3. The same, exterior of left valve.
4.* *Lophocardium Annettæ* Dall, 29.0; p. 264.
5.* *Callocardia guttata* A. Adams, 17 by 17.5; from a drawing by Mr. Edgar A. Smith of the unique type in the British Museum; p. 267.
6. *Callocardia* (*Callogonia*) *Leeana* Dall, 20.0; p. 269.
7. The same, hinge of right valve from below, old specimen, 35.0.
8. The same, left valve.
9. The hinge (Fig. 7), viewed from the left, right valve.
10.* *Malletia goniura* Dall, 15.5; p. 251.
11.* *Cymatoica occidentalis* Dall, 12.5; p. 272.
12. *Cymatoica orientalis* Dall, 9.5; p. 273.

PLATE XI.

FIG. 1. *Pteronotus phaneus* Dall, 17.0; p. 330.
2. *Pecten* (*Pseudamusium*) *strigillatum* Dall, 9.0; p. 250.
3. *Eupleura Stimpsoni* Dall, 12.0; p. 331.
4. *Crassatella floridana* Dall, 50.0; p. 260.
5. *Benthonella gaza* Dall, 8.0; p. 338.
6. *Marginella cineracea* Dall, 14.0; p. 310.
7. *Mitra Bairdii* Dall, 35.0; p. 315.
8. *Scala babylonia* Dall, 30.0; p. 332.
9. *Pecten effluens* Dall, 26.0; p. 249.
10. *Peristichia toreta* Dall, 10.75; p. 334.
11. *Cyclostrema cistronium* Dall, alt. 1.6; p. 354.

PLATE XII.

FIG. 1.* *Haliotis Pourtalesii* Dall, upper surface, a calcareous foraminifer adhering near the margin of the aperture; 23.0; p. 355.
2. *Adeorbis sincera* Dall, 3.25; p. 338.
3.* *Haliotis Pourtalesii* Dall, front view; 23.0; p. 355.
4. *Calliostoma Coppingeri* Smith, 10.0; p. 344.
5. *Calliostoma Riöensis* Dall, 15.0; p. 345.
6.* *Solariella oxybasis* Dall, 13.5; p. 352.
7.* *Actæon perconicus* Dall, 5.0; p. 296.
8. *Solariella actinophora* Dall, alt. 7.25; the aperture is somewhat broken on the base; p. 353.
9.* *Nassa Townsendi* Dall, 10.0; p. 326.

10.* *Pleurotomella suffusa* Dall, 31.5; p. 308.
11. *Solariella actinophora* Dall, view from above; maximum diameter, 9.0. In the figure the radiations lying between the suture and the first spiral rib are not represented as sufficiently numerous or conspicuous on the last whorl; p. 353.
12.* *Scaphander interruptus* Dall, 33.0; p. 297.

PLATE XIII.

FIG. 1. *Nucula cymella* Dall, 51.0; p. 258.
2. *Thracia Stimpsoni* Dall, 65.0; p. 275.
3.* *Malletia* (*Tindaria*) *virens* Dall, 4.5; p. 254.
4. *Malletia* (*Tindaria*) *acinula* Dall, 5.0; p. 253.
5.* *Leda pontonia* Dall, from above, 14.5; p. 257.
5*b*. *Leda pontonia* Dall, side view, 14.5; p. 257.
6. *Yoldia scapania* Dall, 18.25; p. 254.
7. *Leda cestrota* Dall, 25.5; p. 255.
8. *Yoldia pompholyx* Dall, 4.0; p. 255.
9. *Nucula callicredemna* Dall, 12.5; p. 258.
10. *Malletia* (*Tindaria*) *agathida* Dall, 5.5; p. 252.
11. *Cytherea eucymata* Dall, 40.0; no attempt has been made to reproduce the color-pattern in this figure, which was drawn from a bleached specimen; p. 271.
12. *Myonera paucistriata* Dall, 10.0; p. 283.
13. *Cuspidaria* (*Luzonia*) *chilensis* Dall, 11.0; p. 282.

PLATE XIV.

FIG. 1. *Cryptodon pyriformis* Dall, 14.0; p. 263.
2. *Cryptodon fucgiënsis* Dall, 25.0; p. 262.
3. *Cryptodon ovoideus* Dall, 25.0; p. 263.
4. *Nucula Verrillii* Dall, 5.0; p. 257.
5. *Semele inaculoides* Conrad, 5.0; p. 274.
6. *Lucina leucocyma* Dall, from above; p. 263.
7. *Lucina leucocyma* Dall, 6.5; p. 263.
8. *Veneriglossa vesica* Dall, front view of right valve, 21.0; p. 270.
9. *Limæa Brouniana* Dall, 3.5; p. 250.
10. *Limatula setifera* Dall, 9.0; p. 250.
11. *Lucina sagrinata* Dall, 7.6; p. 263.
12. *Veneriglossa vesica* Dall, alt. 21.0; p. 270.
13. *Lucina sombrerensis* Dall, 6.5; p. 263.

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